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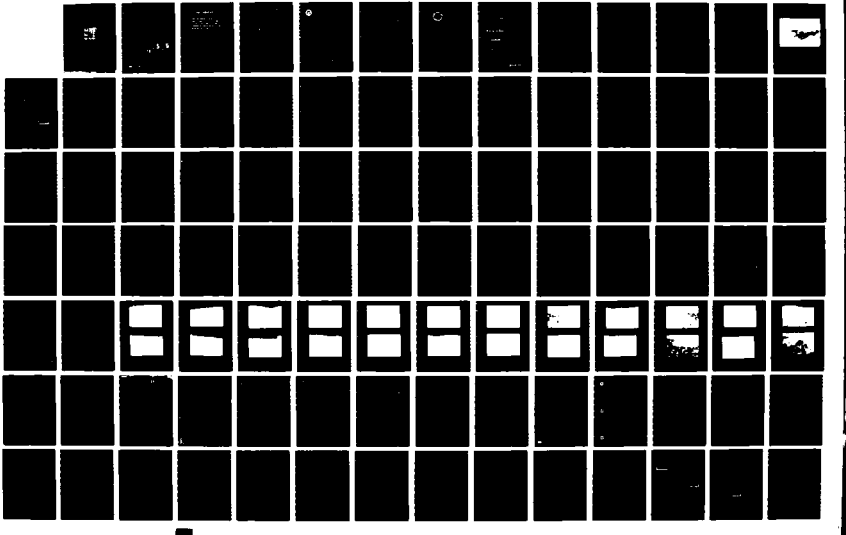
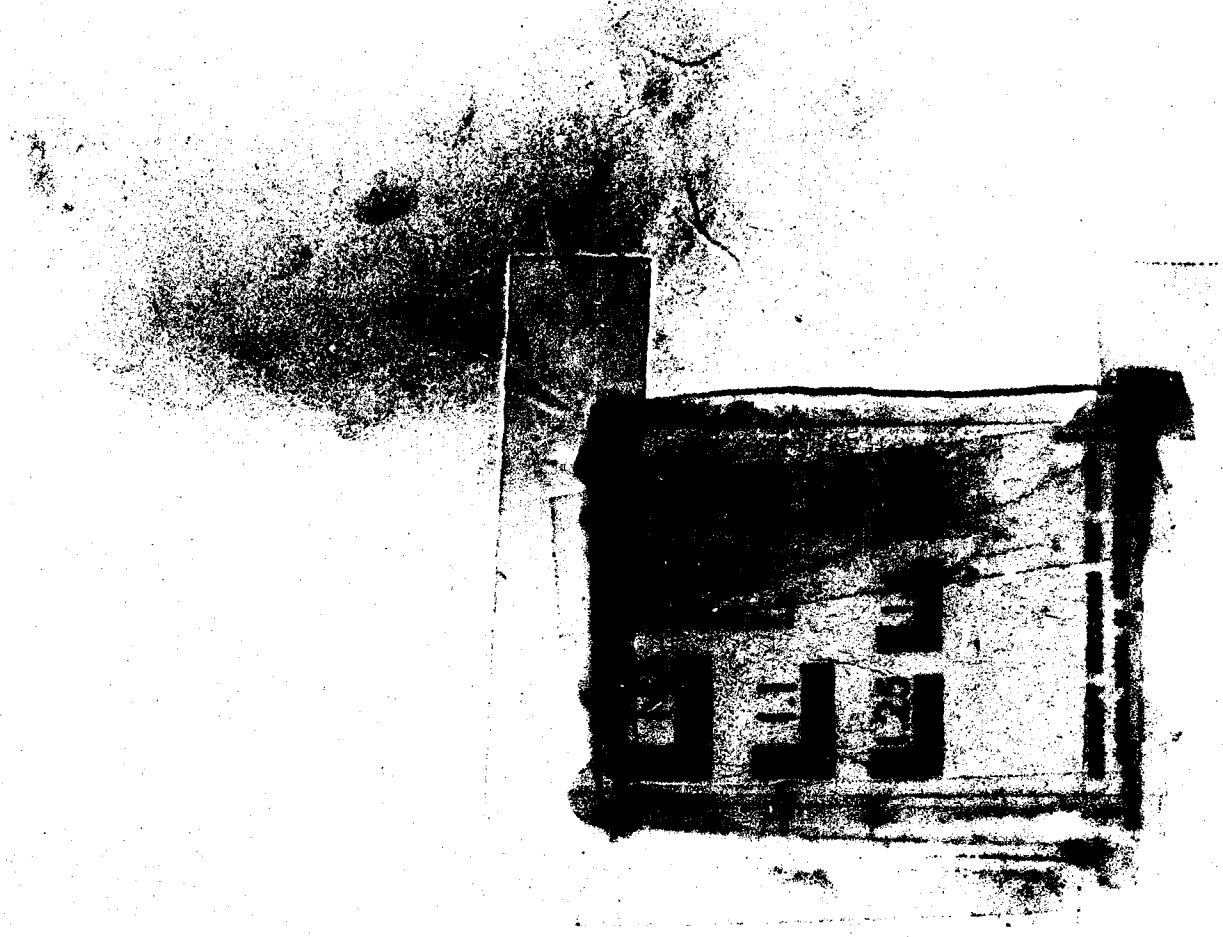
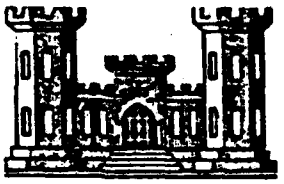




CONNECTICUT RIVER BASIN
LUDLOW, VT

JEWELL BROOK DAM SITE NO. 5
VT 00017

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

APRIL 1980

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: VT 00017	2. GOVT ACCESSION NO.: AD-A157229
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Jewell Brook Dam Site No. 5 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254	12. REPORT DATE: April 1980 13. NUMBER OF PAGES: 55
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Ludlow, VT.
Sanders Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a 650 ft. long 113 ft. high earth dam. The dam is in fair condition due to the erosion of the spillways and training dikes during a test flood. The dam is large in size with a high hazard potential. The test flood for the dam is equal to the full PMF. It is recommended that the owner engage a registered qualified engineer to investigate the adequacy of the relief walls. There are also various remedial measures which must be implemented by the owner, should

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

AUG 26 1980

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, Vermont 05602

Dear Governor Snelling:

Inclosed is a copy of the Jewell Brook Dam Site No. 5 Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, Town of Ludlow, Ludlow, Vermont 05149.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Water Resources for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

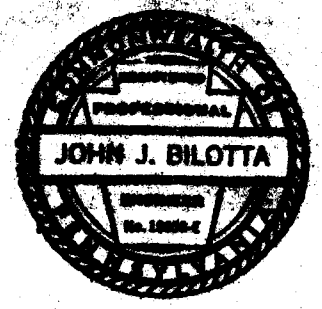
Identification No.:	VT00017
Name of Dam:	Jewell Brook Dam Site No. 5
Town:	Ludlow
County and State:	Windsor, Vermont
Stream:	Sanders Brook
Date of Inspection:	November 6, 1979

Jewell Brook Dam Site No. 5 is a 650-foot long, 113-foot high earth dam located on Sanders Brook. This dam is a homogenous, compacted earth fill dam with side slopes of 3H:1V upstream and 2.5H:1V downstream. The appurtenant works consist of a principal spillway and two emergency spillways. The emergency spillways are 150-foot wide earth channels cut into the glacial till of each abutment. The cutoff was carried down to glacial till under the dam. The principal spillway is a reinforced concrete intake structure located in the center of the dam. It has a spillway weir which drops flows to a 30-inch diameter reinforced concrete pressure pipe conduit that discharges into a riprapped plunge pool at the conduit outfall. A gated 18-inch reinforced concrete pipe reservoir drain is connected to the intake structure. Engineering information available consisted of as-built drawings, the design notebook, past inspection reports and a watershed study.

The dam is in fair condition due to the potential for erosion of the spillways and training dikes during a test flood. Other aspects of the dam are judged to be in good condition. The inspection revealed minor erosion caused by settlement at the abutments, unauthorized trespassing by motorcycles and off-the-road vehicles, small burrowing animals, wave erosion and discharge from the internal drain system. The durability under flood flows of the grass on the spillway surface is questionable, and evidence of sloughing was noted on the left training dike of the right spillway. The left emergency spillway would discharge flood waters near the downstream toe of the dam. In accordance with Corps of Engineers Guidelines for the Large Size and High hazard classification of the dam, the test flood will be equivalent to the Probable Maximum Flood (PMF). Peak inflow to the reservoir is 4,500 cubic feet per second (cfs); peak outflow is 3,850 cfs with 3.4 feet of freeboard. With a water level at the crest of the dam, the capacity of the spillways is 10,925 cfs, which is equivalent to 280 percent of the routed test flood outflow.

It is recommended that the owner engage a registered qualified engineer to investigate the adequacy of the relief wells, a means of providing access to the dam embankment when flow is occurring over the spillways, the erosion potential erosion of the spillways, the dike and the downstream toe during flood flows, and the sloughing of the left training dike of the right spillway. Recommendations should be made by the engineer and implemented by the owner.

The recommendations and remedial measures are described in Section 7 and should be addressed within one year after receipt of this Phase I Inspection Report by the owner.



Very truly yours,

DuBois & King, Inc.

John J. Bilotta, P.E.
Project Manager

This Phase I Inspection Report on Jewell Brook No. 5 has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

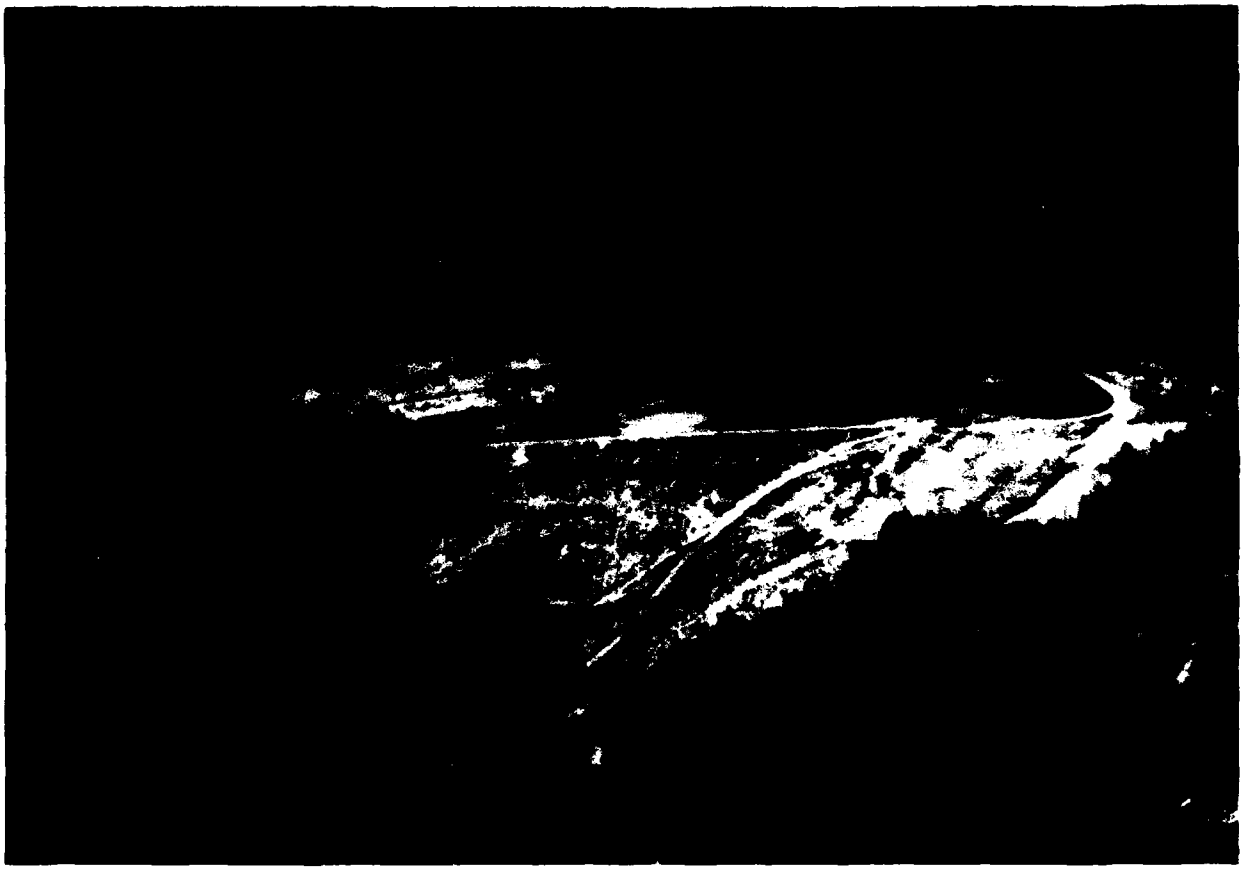
This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

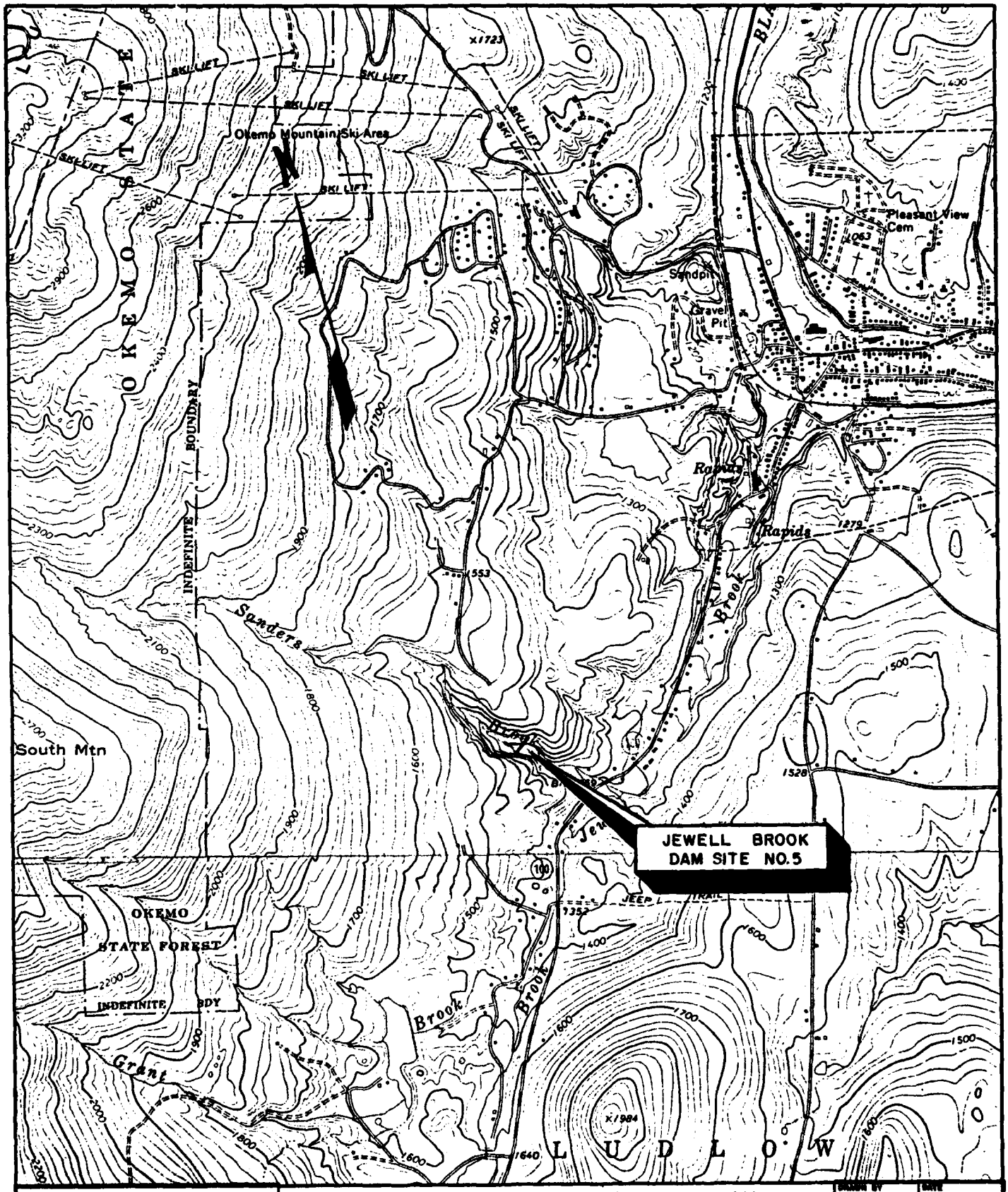
It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably-possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that

TABLE OF CONTENTS



OVERVIEW PHOTOGRAPH
JEWELL BROOK DAM SITE NO. 5



DuBois & King INC.
engineering and environmental services
RANDOLPH, VERMONT / CONCORD NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

JEWELL BROOK DAM SITE NO. 5

LOCATION MAP

USGS QUAD. LUDLOW, ANDOVER VERMONT

DRAWN BY: JAS	DATE: 2/80
CHECKED BY: RMC	PROJ. NO.: 91114
PROJ. ENG.	DRWG. NO.

SCALE: 1" = 2000'

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
JEWELL BROOK SITE NO. 5 DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. DuBois & King, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to DuBois & King, Inc., under a letter of October 19, 1979 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0003 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to quickly initiate effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Jewell Brook Site No. 5 Dam is located in the Town of Ludlow, Windsor County, Vermont. The dam is located on Sanders Brook approximately 2,200 feet upstream of its confluence with Jewell Brook. The dam is shown on the 7.5 minute U.S.G.S. quadrangle for Ludlow, Vermont, with coordinates approximately 72° 43.3' west longitude, 43° 22.8' north latitude. The location of the Jewell Brook Site No. 5 Dam is shown on the Location Map immediately preceding this page.

b. Description of Dam and Appurtenances. Jewell Brook Site No. 5 Dam is a homogeneous earth embankment approximately 650 feet long and 113 feet high, with a shallow cutoff trench into the foundation. The downstream face is grassed and has a slope of 2.5 feet horizontal to 1.0 feet vertical. The upstream face has a slope of 3.0 feet horizontal to 1.0 feet vertical, is grassed on the upper sections, and is stone-lined on the lower sections. A drainage system is located under the downstream portion of the dam. Three foundation relief wells have been installed downstream from the toe. Three spillways provide flow control, a principal spillway in the center of the dam for normal flow and two emergency spillways for overflow. The principal spillway is a drop inlet structure consisting of a single-stage reinforced concrete intake structure that connects to a 30-inch diameter reinforced concrete pipe which discharges into a plunge pool. A reservoir

drain is connected to the intake structure by a gated 18-inch diameter concrete conduit. There are two 150-foot emergency spillways, one in each abutment. They both have a crest elevation at 1490.0 NGVD, side slopes of 3H:1V, and are grassed.

c. Size Classification. Jewell Brook Site No. 5 is 113 feet high and has a storage capacity of 280 acre-feet. In accordance with article 2.1.1 of the Recommended Guidelines for Safety Inspection of Dams, the dam is Large in size based upon its height which is greater than 100 feet.

d. Hazard Classification. The dam has a hazard classification of High based upon its potential for damage. Development downstream of Jewell Brook Site No. 5 Dam consists of semi-rural housing units and farm buildings along Jewell Brook. Approximately 1.7 miles downstream from the dam lies the Village of Ludlow. A flood wave generated by a breach of this dam would produce a stage of 17.6 feet above stream bed when it reached the confluence of Sanders and Jewell Brook. The resulting 13.6-foot high flood wave would have the potential of damaging 2 bridges on Vermont Highway 100 and causing appreciable damage to 20 dwellings along Jewell Brook with flood levels approximately 10 feet above the first floor elevations of some of those dwellings. It is likely that more than a few lives may be lost if the dam is breached.

e. Ownership. This dam is owned by the Town of Ludlow, Vermont 05149.

f. Operator. The dam is operated and maintained by the Town of Ludlow, Vermont 05149. Mr. Dean Brown, Town Manager, is in charge. His telephone number is 802/228-2841.

g. Purpose. The purpose of this dam is to provide flood protection for the Jewell Brook flood plain area. It will retard the runoff from a 100-year frequency storm without discharge occurring in the emergency spillways.

h. Design and Construction History. The Jewell Brook Site No. 5 Dam was constructed in 1972. The dam was designed and constructed by the Soil Conservation Service for the Town of Ludlow. The construction of the dam was funded under the authority of the "Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended. The Town of Ludlow paid for the acquisition of the required land, easements, and rights-of-way.

i. Normal Operating Procedure. The operation of Jewell Brook Site No. 5 Dam is automatic. The conservation pool is maintained by the principal spillway weirs at elevation 1446.3 NGVD. As inflow increases, the capacity of the conduit is exceeded and the water level rises. The emergency spillways, being to function when the water rises above elevation 1490 NGVD.

The reservoir drain is manually operated, as needed.

1.3 Pertinent Data

a. Drainage Area. The drainage area of Jewell Brook Site No. 5 is 1.74 square miles. The terrain is mostly forested and is steep and mountainous. Topographic elevations in the watershed range from about 1380

feet to 3340 feet NGVD. The basin is sparsely populated, and there are few roads or structures. Okemo State Forest covers a majority of the drainage area. The main tributary to Dam Site No. 5 is Sanders Brook, a short, relatively straight, high gradient mountain stream. Normal and maximum pool levels represent approximately 0.1 percent and 1.3 percent, respectively, of the drainage area.

b. Discharge at Dam Site

(1) Outlet Works. A 30-inch diameter reinforced concrete conduit is located in the center of the dam. Based on as-built drawings, the conduit is 485 feet long, has a slope of 0.06 feet per foot and has 23 reinforced concrete, anti-seep collars. A 33-foot tall reinforced concrete intake structure controls inflow into the conduit. Flow normally passes over a 15-foot wide weir at the crest of the intake structure at elevation 1446.3 feet NVGD (50 feet below the top of the dam). A reservoir drain, at elevation 1426.5 NGVD consists of a gated 18-inch conduit which is connected to the bottom of the intake structure.

One 150-foot wide emergency spillway is located, in each abutment. Both spillways have a crest at elevation 1490 NGVD and pass any overflow which the principal spillway is unable to handle.

(2) Maximum Known Flood. Based on a 1964 watershed study report entitled "Jewell Brook Watershed," the Jewell Brook Watershed has produced damaging floods in 1927, 1936, 1938, 1952 and 1960. It is stated in the report that the 1938 flood was the most severe and that recurrence of a flood of this magnitude could cause damages of $870,000 (1964 figures). The majority of the damage occurred in the Village of Ludlow. Industrial, commercial and residential property, roads and bridges all received extensive flood damage from Jewell Brook and the Black River.

Since construction in 1972, the Jewell Brook Dam Site No. 5 has withstood floods in 1973 and 1976. The 1976 flood was reportedly the worst of the two events. There are no records of maximum pool elevations or discharge through the emergency spillway.

(3) Spillway Capacity at Test Flood Elevation. The ungated spillway capacity at the test flood elevation is 3,850 cfs. This capacity is the combined flows of the principal and the two emergency spillways at elevation 1493.2 NGVD. The principal spillway will discharge 170 cfs at the test flood elevation.

(4) Spillway Capacity at Top of Dam. The spillway capacity at the top of dam is 10,925 cfs. This capacity is the combined flow of the principal and the two emergency spillways. The emergency spillways will discharge 10,750 cfs and the principal spillway will discharge 175 cfs with a water surface at the top of the dam.

(5) Total Project Discharge. The total project discharge at the top of the dam is 10,925 cfs at elevation 1496.6 feet NGVD. This discharge is the combined flows of the principal and emergency spillways. The emergency spillway will discharge 10,750 cfs and the principal spillway will discharge 175 cfs with a water surface at the top of the dam.

c. Elevation (NGVD)

(1) Streambed at toe of dam	1384±
(2) Bottom of cutoff	1403 (lowest point)
(3) Maximum tailwater	N/A
(4) Conservation pool	1446.3
(5) Full flood control pool	1490.0
(6) Emergency Spillway Crest (ungated)	1490.0
(7) Design surcharge (Original Design)	1493.4
(8) Top of dam	1496.6
(9) Test flood design surcharge	1493.2

d. Reservoir (Length in feet)

(1) Normal pool	1000±
(2) Flood control pool	1500±
(3) Spillway crest pool	1500±
(4) Top of dam	1500±
(5) Test flood pool	1500±

e. Storage (acre-feet)

(1) Normal pool	9.7
(2) Flood control pool	186
(3) Spillway crest pool	186
(4) Top of dam	280
(5) Test flood pool	262

f. Reservoir Surface (acres)

(1) Normal pool	1.2
(2) Flood-control pool	11.0

(3) Spillway crest	11.0
(4) Test flood pool	13.0
(5) Top of dam	14.7

g. Dam

(1) Type	Earth
(2) Length	650 feet
(3) Height	113 feet
(4) Top Width	14 feet
(5) Side Slopes	Upstream 3H:1V Downstream 2.5H:1V

(6) Zoning - Essentially homogeneous, with drainage from downstream side of cutoff trench and horizontal blanket drain of coarser borrow beneath downstream third of downstream shell.

(7) Impervious Core - None, See "Zoning."

(8) Cutoff - Cutoff trench down to glacial till and composed of of same compacted material as is in embankment.

(9) Grout Curtain - None.

(10) Other - This dam has two emergency spillways, one on each abutment. Three relief wells exist about 25 feet down stream from the toe to drain flow through the foundation soils.

h. Diversion and Regulating Tunnel

Not applicable.

i. Spillways

Principal Spillway	
Type	Two weirs
Size	7.5 feet long each
Elevation	1446.3 NGVD
Emergency Spillways	
Type	Two grassed channels
Size	150 feet wide, each
Elevation	1490.0 NGVD

j. Regulating Outlets

The only gated outlet is an 18-inch diameter reservoir drain at elevation 1426.5 NGVD. This is operated only to drain the reservoir and is not a part of the usual procedure to regulate pool levels.

SECTION 2

ENGINEERING DATA

2.1 Design

There are two available sources of design information concerning the original construction of the dam. A watershed work plan entitled "Jewell Brook Watershed" published in 1964 provided background information concerning the construction of the dam. The purpose of the report was to analyze the needs of the Jewell Brook Watershed and to make recommendations. The report contains a summary of past flooding damages and a benefit-cost comparison to determine the most cost-effective solution. Construction of four flood-control dams in the Jewell Brook Watershed was recommended.

The other source, the Jewell Brook Site No. 5 design notes, provided specific design information. The design notes include information on geology, soils, hydrology, and structural analysis. The data contain detail calculations and contract drawings and specifications.

2.2 Construction Data

A set of as-built drawings of the original construcion of the Jewell Brook Site No. 5 Dam is available. The drawings are detailed and are in good condition. The drawings consist of 23 photostatic reductions.

2.3 Operation Data

There is an operation and maintenance handbook for Jewell Brook Site No. 5 Dam in the Ludlow Town Office. There are procedures for monitoring the structure. The Vermont Department of Water Resources and the Soil Conservation Service preform a joint inspection of the dam annually.

2.4 Evaluation of Data

a. Availability. A copy of the watershed work plan entitled "Jewell Brook Watershed" is available from the Woodstock Soil Conservation District, Woodstock, Vermont 05091. As-built plans and the original design notes are kept on file by the main office of the Soil Conservation Service. This information is available at the following address: Soil Conservation Service, 1 Burlington Square, Suite 205, Burlington, Vermont 05401. Copies of annual field inspeciton reports are also available from that office.

b. Adequacy. The availability of in-depth engineering data permitted a review of the original design. Technical data pertaining to the original construction of the dam such as materials used, soils gradation and compaction data were readily available. As-built plans and design notes provided adequate data for a Phase I inspection.

c. Validity. The as-built drawings and the design data appear accurate.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Jewell Brook Site No. 5 was performed on November 6, 1979. The weather was sunny and mild with temperatures near 45°F. The inspection team included personnel from DuBois & King, Inc.; Geotechnical Engineers Inc.; and Knight Consulting Engineers, Inc. A copy of the inspection checklist as completed during the field inspection is included as Appendix A. At the time of the inspection, the reservoir water surface was at an elevation of 1446.3, and water was passing over the weirs of the principal spillway which is the usual mode of operation.

b. Dam. Jewell Brook Site No. 5 Dam is an earth embankment approximately 650 feet long and 113 feet high. The downstream face (Photo 1) is grassed and has a side slope of 2.5 horizontal to 1 vertical (Photo 2). The upstream face has a side slope of 3 horizontal to 1 vertical and is grassed (Photo 3). According to the design notes, a crest drain was installed for frost protection. The area downstream of the outfall of this drain (Photo 4) is eroded and swamp grass is growing downstream from the outlet. There is some evidence that fine-grained soil particles have in the past been discharged from this drain.

Indications of trespassing are prevalent. There are ruts formed by vehicular traffic along the downstream left abutment contact line (Photo 5) and along the downstream slope between the training dike for the left emergency spillway and the toe of the dam (Photo 6). The road across the crest is bare and erodible (Photo 7), and erosion is occurring along the vehicle tracks which traverse the downstream face of the dam and at the lower ends of the abutment contact lines. Small animal holes and minor erosion beneath the rootmat were found on the downstream face.

At the pool level, the upstream slope is wave cut, and 10-inch high scarps have developed.

c. Appurtenant Structures. Appurtenant structures consist of a principal spillway, two emergency spillways, a reservoir drain, and a toe drainage system. The principal spillway consists of a concrete intake structure connected to a 30-inch conduit and a plunge pool. Each abutment has a 150-foot wide, grassed, emergency spillway. A drainage system is located on the downstream portion of the dam.

Emergency Spillways - The left emergency spillway has a grassed channel. A bare-dirt road traverses the spillway channel (Photo 8), and vehicle tracks are prevalent on the discharge channel (Photo 9).

The right emergency spillway also has a grassed channel (Photo 10). There are some vehicle tracks along the downstream portion of the channel (Photo 11). There is an interceptor drain along the top of the cut of

the right slope of the right emergency spillway. Flow in a downstream direction is reversed by a dike, and continues along a bench in the slope (Photo 12), and empties into the reservoir near the entrance channel to the right emergency spillway. There are several depressions along the bank below the interceptor drain (Photo 13) which appear to be 18 inches deep. On the day of the inspection, the stream was approximately 3.5 feet wide and several inches deep (Photo 14). The flow rate varied from 5 gpm at the highest point to about 250 gpm.

The interceptor drain empties into a rock-lined channel in the approach to the right side emergency spillway. There is considerable erosion at the top of the rock-lined channel (Photo 15); this channel covers a large area of the upstream right valley wall (Photo 16). Some erosion, or a small slip, has occurred just above the waterline at the middle of the right spillway inlet channel.

The training dike along the left side of the right emergency spillway appears to have sloughed on the side toward the toe of the dam (Photo 17). An investigation is required to determine the stability of this portion of the dike.

Principal Spillway - The pool level is controlled by the weir at the top of the intake structure (Photo 18). The structure was unobstructed and water was passing over the weir at the time of the inspection. Bituminous joints between the concrete pipe sections of the outlet conduit are starting to crack, and minor undermining of the concrete cradle was noticed.

Plunge Pool - The outfall of the principal spillway empties into a plunge pool (Photo 19) which is lined with large riprap. The plunge pool appeared to be well shaped with very little displacement of the rock (Photo 20).

Toe Drains - The toe drains that are shown on the plans exit into the plunge pool. These were not observed during inspection, probably because they are covered with the stone protection that lines the plunge pool.

Relief Wells - Three relief wells were drilled during construction to drain water from an artesion aquifer that had been discovered during site exploration. These relief wells are 20 to 30 feet deep and collect water through wellpoints that were inserted below a 4-inch casing into the aquifer (Photo 21). On the day of inspection the elbow to the right in Photo 21 was flowing at one-quarter gpm, in the center at one to two gpm, and to the left at one-quarter gpm (Photo 22). Thirty feet to the right of the outlet conduit, a broken pressure gage was found attached to a 1-inch diameter pipe. It had been used to measure the artesion pressure in the aquifer before the relief wells were installed. The above information about the construction of the relief wells was obtained from Paul Carlson of the SCS in Burlington, Vermont.

d. Reservoir Area. There are some trees adjacent to the normal water level but there was no indication of any that were likely to fall into the reservoir (Photo 23). The area was relatively clear with only occasional forest litter.

e. Downstream Channel. The downstream channel is a natural channel with cobbles and boulders along the channel floor (Photo 24). There were no loose rocks or trees overhanging the channel.

3.2 Evaluation

Several areas are eroding and require maintenance. The grassed surface of the emergency spillways may be insufficient to withstand design flood flows. Evaluation of the adequacy of the grass cover of the spillways are discussed in Section 6.

The water emanating from the crest drain requires repair and annual observation in the springtime to check on removal of fines.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Jewell Brook Site No. 5 Dam serves as flood control for the Jewell Brook watershed. Its operation is automatic. The water elevation of the pool is regulated by the hydraulic capacity of the concrete intake structure which is the principal spillway. A 1.2 acre permanent pool is maintained by the riser crest at elevation 1446.3 NGVD. The weirs of the principal spillway control the water surface until the capacity of the conduit is exceeded (approximately 170 cfs). The emergency spillways begin to function when the water level reaches elevation 1490 NGVD.

The permanent pool can be drained or lowered by manually opening the reservoir drain (elevation 1426.5). The drain consists of a drain inlet and an 18-inch diameter corrugated metal pipe connected to the principal spillway intake structure. Flow into the reservoir drain is controlled by a sluice gate located inside the intake structure. Its hand operated mechanism is located on top of the intake structure. During low pool, when the water level is below the top of the intake structure, access is by boat.

b. Warning System. There is no automatic system to warn of an impending flood or to warn of possible overtopping. The Woodstock Soil Conservation District office personnel visually inspect the dam during heavy flows as a safety precaution.

During flood conditions, flows passing over the emergency spillways would prevent access to the main dam embankment.

4.2 Maintenance Procedures

a. General. There is no set schedule for maintaining the dam. The dam is inspected jointly by the Soil Conservation Service and the Department of Water Resources on an annual basis. Town officials and maintenance personnel periodically make a visual inspection of the dam to check for unusual conditions. The town manager hires a local farmer to mow the grass on the slopes of the dam at least once a year. Local officials have stated that trespassing on the dams is a problem. Vehicle tracks are visible on the slopes of the dam. Local officials have installed gates to prevent motorists from driving their vehicles on the slopes. The gates have reduced the vehicular traffic, but they have not totally corrected the problem. The tracks caused by the vehicles could lead to future erosion problems.

4.3 Evaluation

No severe operational or maintenance deficiencies were found. The dam has required little maintenance since its original construction.

Some minor problems were detected. Trespassing by motor vehicles could lead to serious erosion in the future if unchecked. The owner should undertake a strict policy of enforcing no trespassing on the slopes of the dam. These actions could include policing and imposing fines on individuals caught violating

the no trespassing regulation. The inaccessibility of the main dam embankment when flow is occurring over the emergency spillways is an undesirable situation. The owner should undertake measures to make the dam accessible during flood conditions.

The owner should establish written procedures for operating and maintaining the structure. The written procedures should include a formal warning and surveillance plan, including round-the-clock monitoring during times of heavy precipitation.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Jewell Brook Site No. 5 was designed as a flood control structure. It has a principal spillway and two emergency spillways. The principal spillway is a reinforced concrete drop inlet structure connected to a 30-inch diameter reinforced concrete conduit which discharges into a plunge pool. The total weir length is 15 feet at a crest elevation of 1446.3 NGVD. The intake structure has inside dimensions of 2.5 feet by 7.5 feet. A reservoir drain is connected to the base of the intake structure; it is a gated, 18-inch diameter pipe with an entrance invert at 1426.5 NGVD.

The emergency spillways are earth cuts in the left and right abutments. Both have base widths of 150 feet and side slopes varying from 3H:1V to 2.5H:1V. They are grassed and have a crest elevation of 1490.0 NGVD.

With the water level at the crest of the emergency spillway, the principal spillway will discharge 170 cfs. The emergency spillway can pass 10,750 cfs with the water level at the dam crest (Elevation 1496.6 NGVD). The normal water surface is elevation 1446.3 NGVD. The normal pool storage of 9.7 acre-feet is only 3.5 percent of the maximum storage of 280 acre-feet. The entire flood control process is automatic, no manual operation being needed to regulate the spillways.

The Jewell Brook Site #5 watershed is characterized by steep and rugged slopes. Its 1.74 square mile drainage area is heavily forested, but the local soil conditions promote a substantial sediment runoff. Provision was made in the normal pool volume for 100 years of sediment accumulation.

5.2 Design Data

Detailed hydrologic information pertaining to the original design of the dam was obtained from the Soil Conservation Service. This information was prepared in accordance with procedures as outlined in the National Engineering Handbook of the Soil Conservation Service, Section 4, Supplement A - Hydrology (NEH 4A) and Section 5 - Hydraulics (NEH 5). The information included a watershed analysis, flood routing, discharge frequency analysis, and dam design criteria. The information was reviewed and found to be in accordance with commonly accepted engineering practice.

5.3 Experience Data

The Jewell Brook watershed has produced several damaging floods in past years. The major floods of record occurred in 1927, 1936, 1938, 1952 and 1960. Nearly every spring, there had been a potential flood danger from rapidly melting snow augmented by rainfall. The flood of September 1938 was the most damaging flood on Jewell Brook.

Jewell Brook Site No. 5 Dam is one of four flood-retarding structures that were constructed to control runoff from the Jewell Brook watershed upstream of Ludlow. Together they control 75 percent of the drainage area. Since construction in 1972, this structure has attenuated floods without dis-

charge occurring through the emergency spillways. Severe storms occurred in 1973 and 1976, the 1976 storm being the more severe of the two. The 1976 flood reportedly rose to within five feet of the emergency spillway crest. The dams have helped alleviate flooding in the Village of Ludlow.

5.4 Test Flood

The 113-foot height of this structure puts it in the Large category with a height greater than 100 feet. The hazard classification is High, based upon the close proximity of the Village of Ludlow and the attendant population. In accordance with the "Recommended Guidelines for Safety Inspection of Dams," the test flood is the Probable Maximum Flood (PMF). The PMF curve envelope for Mountainous Areas was used to obtain a unit discharge per square mile for the smallest available drainage area, two square miles. This unit discharge was multiplied by the actual drainage area, 1.74 square miles, to obtain the PMF inflow of 4,500 cfs. This test inflow was routed through the reservoir assuming the water surface to be initially at elevation 1446.3 feet (normal pool). The structure can pass the full PMF without being overtopped. The resulting surcharge storage would be 252 acre-feet, the freeboard 3.4 feet and the outflow 3,850 cfs. Velocities at the control sections of the emergency spillways would be 8.6 fps. The routed test flood outflow of 3,850 cfs represents a reduction of 14 percent of the test flood inflow.

5.5 Dam Failure Analysis

A hydraulic analysis for dam failure under test flood conditions was performed. Prior to faiure, the water level would be 1493.2 NGVD and the structure would be spilling 3,850 cfs. The breach height (water surface to upstream toe) would be 66.7 feet and the breach would produce an instantaneous discharge of 63,400 cfs.

Since this dam impounds a relatively short reservoir, it was judged that a breach width of 10 percent of the dam width would represent a reasonable estimate for dam failure analysis. Thus, a breach width of 65 feet and depth of water of 66.7 feet were used in the Saint-Venant equation to compute a breach outflow of 59,550 cfs over and above the 3,850 cfs discharged by the structure during the test flood.

The breach would produce a wave 13.6 feet higher than the test flood level in Jewell Brook. The resultant stage would be 17.6 feet at the confluence of Jewell Brook and Sanders Brooks, which is 0.4 miles downstream of the structure. This is expected to inundate approximately 20 houses, producing water levels about ten feet above the first floor levels in some instances. It is considered that this wave would endanger the lives of more than a few people. By the time it reached the populated area of the village, the flood wave would be 4.4 feet high and the stage would be 7.9 feet above stream bed. Here again, the lives of more than a few persons would be endangered and therefore the dam is classified as High hazard.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The spillway channels are grassed and are intended to handle water velocities up to 8.6 fps for several hours. The bare spots on both spillways could be the starting points for erosion. It is questionable whether or not the spillway surfaces, including the training dikes, are sufficiently, resistent to withstand the test flood flows without severe erosion.

The downstream side of the left emergency spillway seems to discharge very close to the toe of the dam. Any significant spillway flow may cause erosion of the toe. Erosion of the right training dike of the left emergency spillway would increase the likelihood of erosion of the dam toe due to spillway flow.

A longitudinal drain was built in the crest to drain water (due to melting of frost) safely down the downstream slope. The visual observations indicate that fines may have emanated from the drain in the past. For this reason it is necessary to inspect the crest drain to ensure that it is properly filtered. And to determine whether or not it should be repaired, removed, or left in place. If left in place, the zone around the outlet should be repaired and proper materials placed to prevent erosion.

Sloughing was observed on the left training dike of the right emergency spillway. The stability of this dike under flood flows should be studied and necessary remedial measures carried out.

6.2 Design and Construction Data

The design of the emergency spillway channel should be checked to determine whether or not the cover should be improved. The Soil Conservation Service has modified its guidelines pertaining to the design of earth spillways since the construction of this dam. Since the dam will impound large volumes of water during storms, rapid erosion of the spillway at those times could impose a greater danger downstream than would exist in the absence of the dam.

6.3 Post-Construction Changes

There are no known post-construction changes to this dam.

6.4 Seismic Stability

This dam is in Seismic Zone 2 and therefore, according to recommended guidelines, does not warrant a seismic stability analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of visual inspection, most aspects of the dam are in good condition. However, due to the potential for erosion of the spillways during test flood flows, the overall condition is judged to be fair.

b. Adequacy of Information. This Phase I inspection report was based on visual inspection, on previous inspection reports by Vermont Department of Water Resources and Soil Conservation Service personnel, on design drawings and specifications, and on Soil Conservation Service design notes.

c. Urgency. The recommendations presented in Sections 7.2 and 7.3 should be carried out within one year upon receipt of this report by the owner.

7.2 Recommendations

The following investigations and needed corrections should be performed under the direction of a registered engineer qualified in the design and construction of dams.

(1) Determine whether or not the emergency spillway channels should be protected against erosion with materials more resistant to erosion than the existing grass cover (Note: The SCS guidelines have been changed and have become more conservative since the construction of the dam).

(2) Determine whether or not the discharge of high (test flood) flows from the left spillway would erode the right training dike and/or the toe of the dam necessary, make recommendations for protecting against such erosion.

(3) Evaluate potential erosion and stability of the left training dike of the right spillway.

(4) Inspect the crest drain and determine whether it should be removed, replaced, or left in place. If left in place, repair outlet to precent erosion.

(5) Investigate the adequacy of the toe drains and downstream relief wells.

(6) Provide a means of access to the main dam embankment when flow is occurring over the emergency spillways.

7.3 Remedial Measures

a. Operation and Maintenance Procedures. The owner should establish written procedures and perform appropriate repairs under the direction of a registered engineer qualified in the design and construction of dams. The following items should be included in these procedures and repairs.

(1) All abutment contact lines have gullies which should be filled with properly filtered erosion protection.

(2) The bare roads and vehicle tracks on the dam and spillways should be vegetated.

(3) The animal holes and small erosion channels under the roots on the downstream face should be filled and protected.

(4) The wave cut scarps at the water line on the upstream face should be protected against further erosion.

(5) The erosion or slide area just above the water line in the middle of the right emergency spillway should be protected.

(6) The discharge from the crest drain be observed in the springtime to determine whether or not fine soil grains are being discharged.

(7) The seepage exiting from the downstream drains should be monitored.

(8) Outlet conduit pipe joint filler should be evaluated and replaced if necessary.

(9) Undermining of the outlet pipe concrete base should be evaluated and repaired if necessary.

(10) Written procedures for operating and maintaining the dam should be established. The written procedures should include a formal downstream warning system and surveillance plan.

(11) Yearly technical inspections should be continued.

(12) To assure operability, drain valve should be operated annually.

7.4 Alternatives

None.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

INSPECTION CHECKLIST

PARTY ORGANIZATION

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

TIME 0930

WEATHER Mostly sunny, approx. 45°F

W.S. ELEV. _____ U.S. ___ DN.S.

PARTY:

1. John Bilotta D&K
2. Jeffrey Spaulding, D&K
3. Steve Poulos, GEI
4. Roy Langell, Knight
5. Paul Carlson, SCS
6. _____
7. _____
8. _____
9. _____
10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Earth Dam	S. Poulos	
2. Concrete & Appurtenences	S. Knight	
3. Hydrology/Electro-Mech.	J. Bilotta	
4.		
5.		
6.		
7.		
8.		
9.		
10		

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	Station 0+00 @ left abutment & crest
Crest Elevation	1496.6 NGVD
Current Pool Elevation	1446.6 NGVD
Maximum Impoundment to Date	1487.1 based on debris at shoraline.
Surface Cracks	None observed.
Pavement Condition	No pavement. Bare soil.
Movement or Settlement of Crest	None observed.
Lateral Movement	None observed.
Vertical Alignment	Satisfactory. Slight rise in middle of the crest.
Horizontal Alignment	Satisfactory.
Condition at Abutment and at Concrete	Downstream Right: Erosion gully at contact up to 18-in. deep flowing ½ gpm at downstream end. Downstream Left: Same, but up to 2-feet deep. Running about 1/8 gpm near bottom. Upstream Left: 0+ gpm flowing at contact. Erosion gully up to 12" deep near upstream end of contact. Standing water just above reservoir surface.
Indications of Movement of Structural Items on Slopes	Intake Structure- not observable. Outlet Structure-OK
Trespassing on Slopes	Entry road blocked by large boulders. Car tracks in grass at both downstream contact lines. Dirt road ungrassed on crest and left spillway.
Sloughing or Erosion of Slopes or	Upstream: Wave cut just above reservoir shoreline. Scarp of about 10" but grass has re-grown. 2+20R; local 5" deep erosion gully. Some grass on it. Many 2-4 inch deep erosion channelets. Downstream, Left side, 30' left: some erosion caused by trespassing. Car track straight down slope (grassed) at Sta 2+85 Rt. Eroding slightly in tracks. Also grassed track at Sta 2+00Rt. One rodent hole at Sta 2+20, 80' right.

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5 DATE November 6, 1979

PROJECT FEATURE NAME S.C. Knight

DISCIPLINE NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT(continued)	
Sloughing or Erosion of Slopes or Abutments (Continued)	Left (2" dia. entrance and exit are 18" apart). Minor bare spots throughout. Wheel tracks on right downstream side now eroding. Up to 6" deep erosion gullies, concentrated on downstream toe and 20' up.
Rock Slope Protection-Riprap Failure	None on slope. OK at outlet structure.
Movement or Cracking at or Near Toe	None observed.
Embankment or Downstream seepage	See "Condition at Abutment".
Piping or Boils	None observed.
Foundation Drainage Features	None.
Toe Drains	See plans. Left 4" elbow flow less than ½ gpm Center 4" elbow flow less than 1-2 gpm Right 4" elbow flow less than ½ gpm±
	1" pipe in ground at toe with broken pressure gage 30' right of outlet conduit. Use not known. Wet around outlets of drains.
Instrumentation System	None.
Vegetation	Waist-high grass.
Crest Drain	At downstream slope Sta 3+45R, 30 ft. left, outlet has eroded slope in past and has been covered with cobbles. Swamp grass grows below drain on slope. Seems to be erosion in progress below outlet.

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
A. Approach Channel	
Slope Conditions	Reservoir bottom.
Bottom Conditions	Below water.
Rock Slides or Falls	None. On right side, about 300 ft.; upstream from dam, channel is protected with riprap (natural ground).
Log Boom	None.
Debris	A few leaves against intake trash racks.
Condition of Concrete Lining	N/A
Drains or Weep Holes	N/A
b. Intake Structure	
Condition of Concrete	Good
Slide Gate	Not observable. No stop logs.

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Excellent above water line where observable.
Condition of Joints	Good.
Spalling	Slightly spalling.
Visible Reinforcing	None.
Rusting or Staining of Concrete	Slight staining - no rusting of concrete.
Any Seepage or Efflorescence	None observable.
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	Not observable.
Cracks	None.
Rusting or Corrosion of Steel	None.
b. Mechanical and Electrical	
Air Vents	None.
Float Wells	None.
Crane Hoist	None.
Elevator	None.
Hydraulic System	None.
Service Gates (Reservoir Drain)	Not observable.
Emergency Gates	None.
Lightning Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System	N/A

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Good.
Rust or Staining on Concrete	Slight staining - no rust.
Spalling	None observable.
Erosion or Cavitation	None seen.
Cracking	Bituminous joints between concrete pipe sections starting to crack
Alignment of Monoliths	N/A
Alignment of Joints	Pipe joints aligned.
Numbering of Monoliths	N/A
	Slight undermining of concrete base under concrete pipe has occurred. (See next shee

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition	N/A
Rust or Staining	
Spalling	
Erosion or Cavitation	Unfiltered riprap around outlet conduit is permitting erosion and some undermining of conduit over the 25 ft. exposed length, as well as at edges (upstream) of the riprap
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	N/A
Channel	
Loose Rock or Trees Overhanging Channel	None. Riprap in fair to good condition.
Condition of Discharge Channel	Good.

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS	
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Left Spillway	Right Spillway
a. Approach Channel		
General Condition	Good.	Good.
Loose Rock Overhanging Channel	None.	None.
Trees Overhanging Channel	Trees on left side.	None.
Floor of Approach Channel	Waist-high grass. Wet.	Waist-high grass.
b. Weir and Training Dikes		
General COndition of Dikes	Good, left & right.	Good, left & right.
Rust or Staining	N/A	N/A
Spalling	N/A	N/A
Any Visible Reinforcing	N/A	N/A
Any Seepage	None.	Rt dike has been protected with crushed cobbels, probably due to groundwater out flow. Marshy just below toe. Benched to control water. Stream on top of bedrock flowing 10-30 gpm.
Drain holes	N/A	N/A
c.Discharge Channel		
General Condition	Good. Some car tracks. Bare surface near weir section.	Good. Some car trac Bare at downstrea left side of weir section.
Loose Rock Overhanging Channel	None.	None.
Trees Overhanging Channel	Forested left side.	Forested both sides.
Floor of Channel	Waist-high grass. Good.	Grassed, waist-high.
Other obstructions	None.	None on weir section but forest of trees immediately downstream.

INSPECTION CHECKLIST

PROJECT Jewell Brook Site No. 5

DATE November 6, 1979

PROJECT FEATURE

NAME S.C. Knight

DISCIPLINE

NAME J.J. Bilotta

NAME S.J. Poulos

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	No service bridge.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Pier	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Conditon of seat & Backwall	

APPENDIX B

ENGINEERING DATA

APPENDIX B

ENGINEERING DATA

Description	Location
1. Design Records - Jewell Brook Site No. 5 Dam	
A. Soil Conservation Service Folder	Soil Conservation Service 1 Burlington Square Suite 205 Burlington, Vermont 05401
B. Watershed work plan entitled "Jewell Brook Watershed", 1964.	Woodstock Soil Conservation District Woodstock, Vermont 05091
2. Past Inspection Reports	
A. List of Past Inspections	Appendix B, pg. B-2
B. Inspection Report Dated May 30, 1979	Appendix B, pgs. B-3 to B-10
C. "O&M Inspection Report" performed on 5/30/79	Appendix B, pgs. B-11 to B-12
D. Other inspection reports	Soil Conservation Service 1 Burlington Square Suite 205 Burlington, Vermont 05401
3. Plans	
A. Plan View - Jewell Brook Site No. 3	Figure B-1 pg. B-13
B. Section of Dam	Figure B-2, pg. B-14
C. Other As-Built Plans	Soil Conservation Service 1 Burlington Square Suite 205 Burlington, Vermont 05401

United States Department of Agriculture
Soil Conservation Service
One Burlington Square
Suite 205
Burlington, Vermont 05401

February 7, 1980

Mr. Don Morin
Dubois & King, Inc.
Randolph, VT 05060

Dear Don:

The dates of the annual operation and maintenance inspections of Jewell Brook Watershed are as follows:

1969 - May 20
1970 - May 26
1971 - June 2
1972 - August 9
1973
1974 - October 3
1975 - June 16
1976 - June 15
1977 - June 9
1978
1979 - May 30 and July 19

I couldn't locate the reports for 1973 and 1978. I know that the inspections were held. I inspected the sites immediately after the 1973 flood.

If I can be of any further assistance, give me a call.

Sincerely,

Paul Carlson

Paul Carlson
Civil Engineer

State of Vermont
Agency of Environmental Conservation
Department of Water Resources
Montpelier, VT 05602

DAM INSPECTION REPORT

Name JERICHO BROOK - (SITE 5) DWR No. 117-5

Town LUDLOW NDS No. VT00 017

Owner TOWN OF LUDLOW Inspection Date 5-30-79

Address c/o TOWN MANAGERS OFFICE LUDLOW, VT Last Inspected 1978 (SCS)

Telephone 228-2841 Hazard Class 1

Dean R. Breault, Jr. - Town Mgr. Size Category

PERSONS PRESENT AT INSPECTION (Name and Organization):

Inspecting Party A. P. BARRANCO, JR - DEPT OF WATER RESOURCES

PHIL CARLSON - SCS, BURLINGTON

Others NONE

I. General Conditions at Time of Inspection

Weather LIGHT RAIN - 55° Ground Conditions WET

Water Surface Elevation ~~-1.8'~~ -1.7' @ 0915 Datum TOP OF RISER

Accessibility SLOPES, E/S SPILLWAYS ACCESSIBLE RISER ONLY ACCESSIBLE BY BOAT. DID NOT GO OUT TO RISER

Reservoir Area SOME FLOATING DEBRIS. POND APPEARS TO BE PARTIALLY SILTED IN

Remarks NO ATTEMPT WAS MADE TO OPEN DRAIN - PROBABLY SILTED IN

II. Condition of Main Structure

Type of Construction EF

A. Upstream Face or Slope

1. Vegetative Cover GOOD GRASS COVER
2. Erosion NONE
3. Slumps, Slides, Cracks NONE OBSERVED
4. Animal Burrows NONE OF SIGNIFICANCE. A FEW SMALL ONES 6' ± ABOVE WL
5. Slope Protection NONE
6. Debris VERY LITTLE @ WL
7. Structural STABLE
8. Abutments OK.
9. Alignment OK
10. Movement NONE APPARENT
11. Remarks GOOD CONDITION

B. Downstream Face or Slope and Toe

1. Vegetative Cover GOOD "GRASS" COVER (MOSTLY BIROSFOOT TREFOIL) EXCEPT AT RIGHT WHERE EXCESSIVE MULCH HAS PREVENTED GROWTH

2. Erosion Gutter erosion at left contact (dirt road). 4WD tracks beginning to erode. Trails go up to crest from area of cattle.

3. Slumps, Slides, Cracks NONE OBSERVED

4. Animal Burrows NONE OBSERVED

5. Slope Protection NONE

6. Debris NONE

7. Seepage TOO WET TO DETERMINE.

8. Piping NONE OBSERVED

9. Boils NONE OBSERVED

10. Toe Drains NOT VISIBLE

11. Scour NONE

12. Structural STABLE

13. Abutments OK EXCEPT FOR EROSION

14. Alignment OK

15. Movement NONE APPARENT

16. Remarks ATV TRAILS HAVE CAUSED DAMAGE PARTICULARLY UP TO BERM ABOVE TOE OF SLOPE

C. Crest

1. Vegetative Cover GOOD GRASS COVER

2. Erosion NONE SIGNIFICANT

3. Evidence of Overtopping NONE

4. Settlement, Cracks NONE OBSERVED

5. Animal Burrows NONE OBSERVED

6. Debris NONE

7. Use of crest (road, trail, etc.) TRESPASSING BY 4WD

8. Structural OK

9. Abutments OK

10. Alignment OK

11. Remarks GENERALLY GOOD

III. Condition of Outlet Works

A. Principal Spillway

Type CONC. RISER

Controlled or Uncontrolled UNCONTROLLED

1. Approach Channel NONE

2. Transition NONE

3. Control Section NOT USABLE

4. Discharge Channel CLEAR

5. Intake Structure APPEARS IN GOOD CONDITION

6. Conduit NOT INSPECTED

7. Outlet Structure OK. - RIDE DISCHARGING TO STONE LINED STILLING BASIN

8. Trash Racks OK

9. Anti-vortex Devices NONE

10. Stop Logs, Flash Boards NONE

11. Remarks WHAT CAN BE SEEN APPEARS GOOD

B. Emergency Spillways (2)

Type ① RIGHT - Vegetated earth cut side channel

② LEFT - Vegetated earth cut

Controlled or Uncontrolled Uncontrolled

1. Approach Channel Both clear - vegetated

2. Transition RIGHT - Badly rutted by 4WD traffic - including left side slope - ponding water (cross-level channel)

3. Control Section Stone

4. Discharge Channel not inspected

5. Remarks ① Steep slope to left of left side of RIGHT EWS leading down to outlet channel that slipped after construction appears to have stabilized ② Drainage channel along ~~left~~ top of ~~right~~ side slope of RIGHT EWS has eroded severely - 5' - bifurcating in places, new bank, over hanging trees. Drains into stone filled chute. ~~Drainage ditch~~ has jumped channel in this area.

C. Drawdown Facilities, Gates, Drains, Appurtenances, Etc.

1. Drawdown Facility 18" Pond drain w/ Rotary Head clear gate - not inspected

Condition probably silted in

2. Other Gates, Drains, Appurtenances Crest drain – 6" ACCMP (Perf) 6' below crest on d/s side opposite outlet – plugged with debris sand/gravel from crest drainage filter. Some

Condition seepage from it and stone fill adjacent to it.

3. Remarks Crest drain should be cleaned.

IV. Operation and Maintenance

① Town has blocked access road but trail bikes & 4WD's get around it through woods and by an old road coming in off Rt. 100.

② Pond was desilted in 1973 and 1976 after floods. Appears to need it again.

V. Inspection Summary

A. Information Obtained

1. Photographs ✓

2. Dimensions

3. Other

B. Additional Information Needed

① Reinspect when slopes are dry

② Inspect conduit –

③ Check gate operability

C. Overall Condition of Dam

Good but trespassing vehicles have caused considerable damage.

VI. General Comments

① Town should continue its efforts to stop vehicle trespassing.
② Town should cut trees overhanging drainage channel along right slope of RIGHT E/S before they fall and block channel. Does not appear that much more can be done in this area, possibly some stone fill added to channel to reduce erosion.

Report By A. Peter Barraco Jr. Date 5/30/79

A. Peter Barraco, Jr. PE
Dam Safety Engineer

Attachments: Photos when developed

5/30/79 1030 Meeting in TM's Brown's office: Dean Brown, Allen Tallevico (SCS), Paul Carlson, BOR. Discussed preliminary findings of inspection.

① Site 5 in good overall condition but vehicle trespassing causing serious damage. Trees s/b cut along drainage channel — possibly add stone fill.

② Town is attempting to purchase an "in holding" that will permit blocking access to dam by back road off Rte 100. Will continue efforts to keep vehicles out.

AB

Copy to SCS 5/31/79
AB

4/79

JEWELL BROOK WATERSHED
Sites No. 1,2,3, & 5

Site No. 5

O&M INSPECTION RECORD

Date of Inspection 5/30/79

STRUCTURE CHECK LIST

S*	U*		S	U
		1. Embankment		
✓		a. Vegetation	✓	
	✓	b. Erosion		✓
✓		c. Leakage	✓	
✓		d. Debris	✓	
✓		e. Wave Damage		✓
	✓	f. Vehicle Damage	✓	
✓		g. Animal Damage	✓	
✓		h. Settlement or Cracking		
N/A		i. Riprap or Stone Facing		
✓		j. Sloughing	✓	
	✓	k. Drain Outlets	✓	
		2. Principal Spillway		
		a. Riser		
✓		(1) Concrete	✓	
✓		(2) Trash Racks	✓	
		(3) Ladder		
✓		(4) Manhole		
NOT CHECKED		(5) Gate	✓	
NOT	CHECKED	b. Conduit	✓	
		(1) Joint Separation		
		(2) Condition of Pipe	✓	
		(3) Infiltration		
✓	✓	(4) Differential Settlement	✓	
		c. Impact Basin		
N/A		(1) Debris, Sediment		
		(2) Concrete		
		d. Plunge Pool/Outlet Channel		
✓		(1) Displaced Riprap		
✓		(2) Scour		
✓		(3) Evidence of Piping		
		3. Emergency Spillway		
✓		a. Vegetation		✓
	✓	b. Erosion		✓
✓		c. Debris/Sediment		
✓		d. Sloughing		
	✓	e. Vehicle Damage		✓
✓		f. Sloughing		
✓		g. Slope Drainage		
		4. Reservoir Area		
✓		a. Debris/Sediment		
✓		b. Undesirable Vegetation		
		5. Borrow Areas		
✓		a. Vegetation		
✓		b. Erosion		
		6. Access Road		
✓		a. Erosion, Potholes		
✓		b. Ditches		
		7. Safety Hazards		
✓		8. Monument		

* S = Satisfactory U = Unsatisfactory

Remarks: (Explain unsatisfactory items above and any other items needing maintenance or repair).

SEE NEXT SHEET

U. S. Department of Agriculture
Soil Conservation Service
Vermont

OPERATION AND MAINTENANCE
WORKSHEET FOR INSPECTION RECORD

Project Jewell Brook W/S Inspection Date 5/30/79

Structure Site No. 5 Type Flood Control Dam

Type of Inspection: Annual [X]

Special [ ]

Sponsoring Local Organization Town of Ludlow

Present for Inspection Paul Carlson, SCS

Pete Baranco, Vt. Dept. of Water Resources

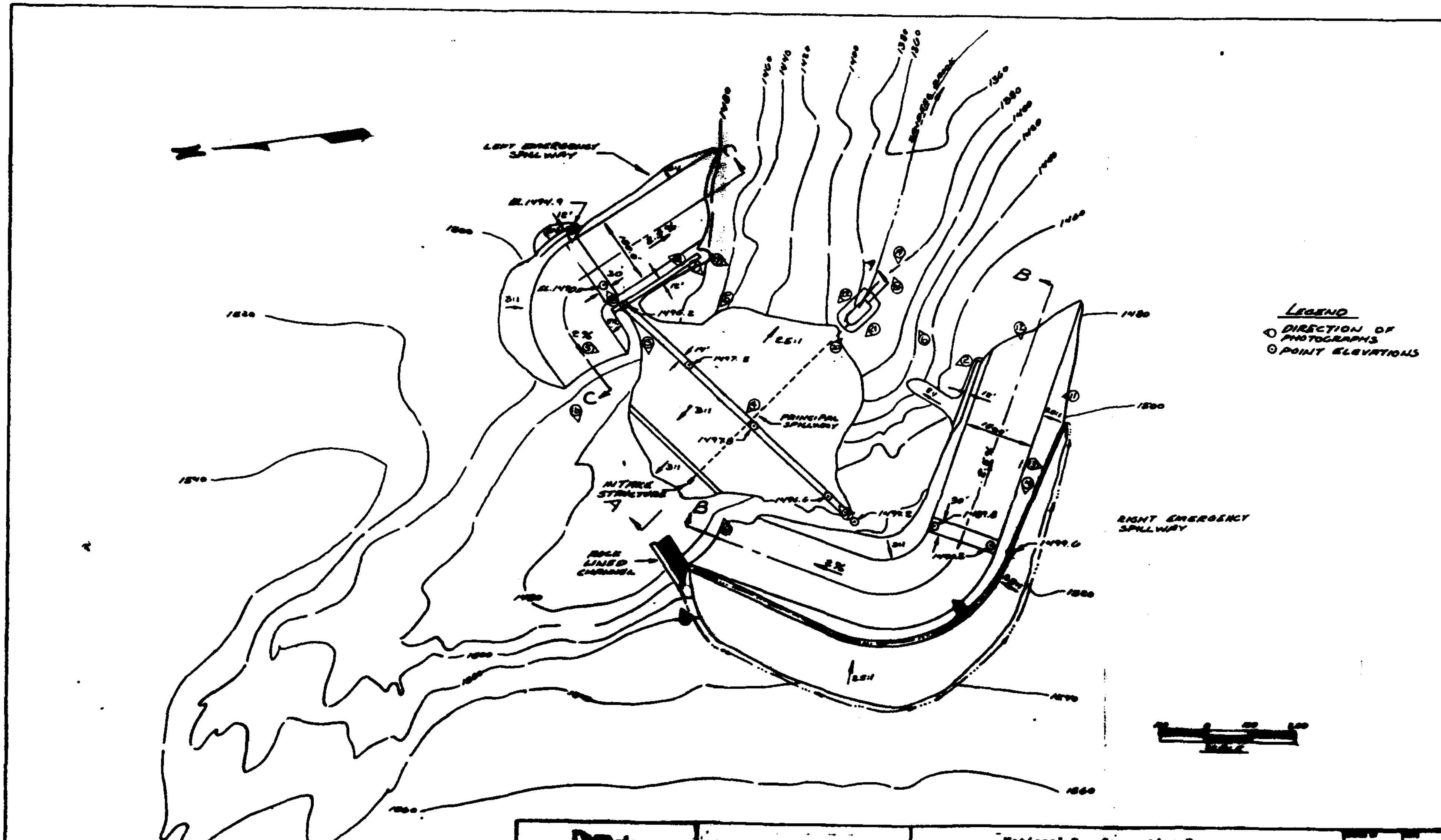
Item	Maintenance & Needed Repairs	Estimated Costs	Agreed Date Repairs to be Completed
1. b.	Fill in d.s. left eroded gutter with crushed stone	$100	
1. f.	Eliminate unauthorized access.		
1. K.	Clear outlet of crest drain	$10	
3. b.	Line ditch above rt. E.S. and cut overhanging trees	$1000	
3. e.	Same as 1.f. above		

REMARKS:

SCS Representative

SLO Representative

Distribution: DC, SLO, State Office

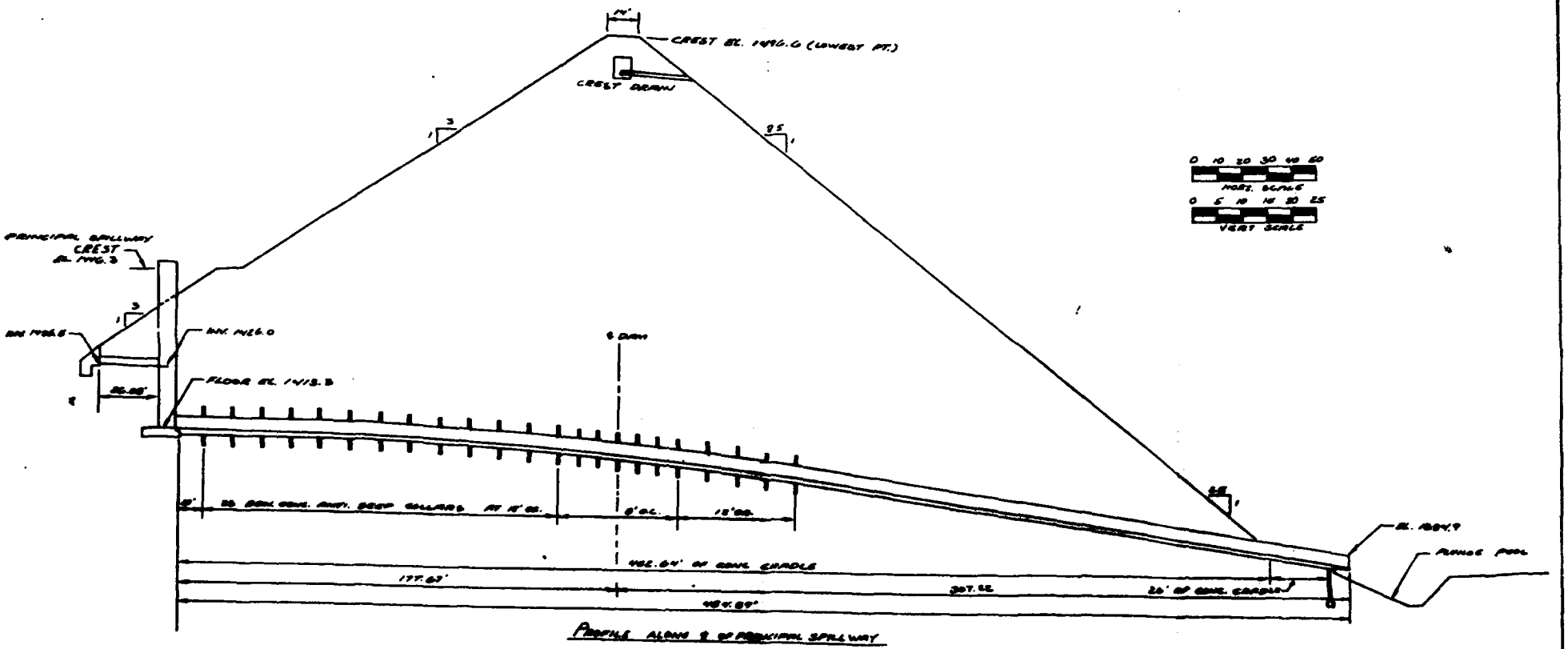


TRACED FROM DRAWING PREPARED BY
USDA SOIL CONSERVATION SERVICE 1970

Department of the Army
New England Division
Corps of Engineers
Waltham, MA 02154

National Dam Inspection Program
Jewell Brook Watershed
Dam Site No. 5
Ludlow, Vermont
General Plan

B-1



PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY

SECTION A-A

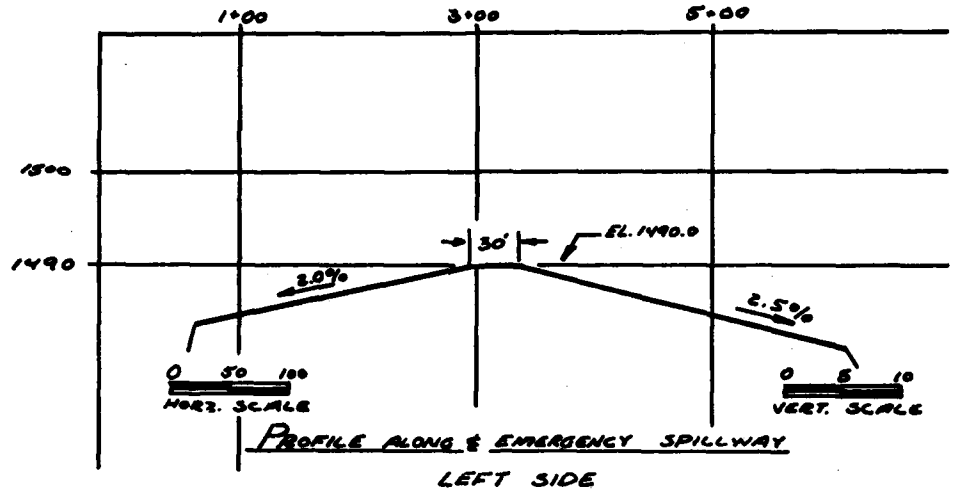
TRACED FROM DRAWING PREPARED BY
USDA SOIL CONSERVATION SERVICE 1970

DuBois & King
engineers/architects/environmental scientists

Department of the Army
New England Division
Corps of Engineers
Waltham, MA 02154

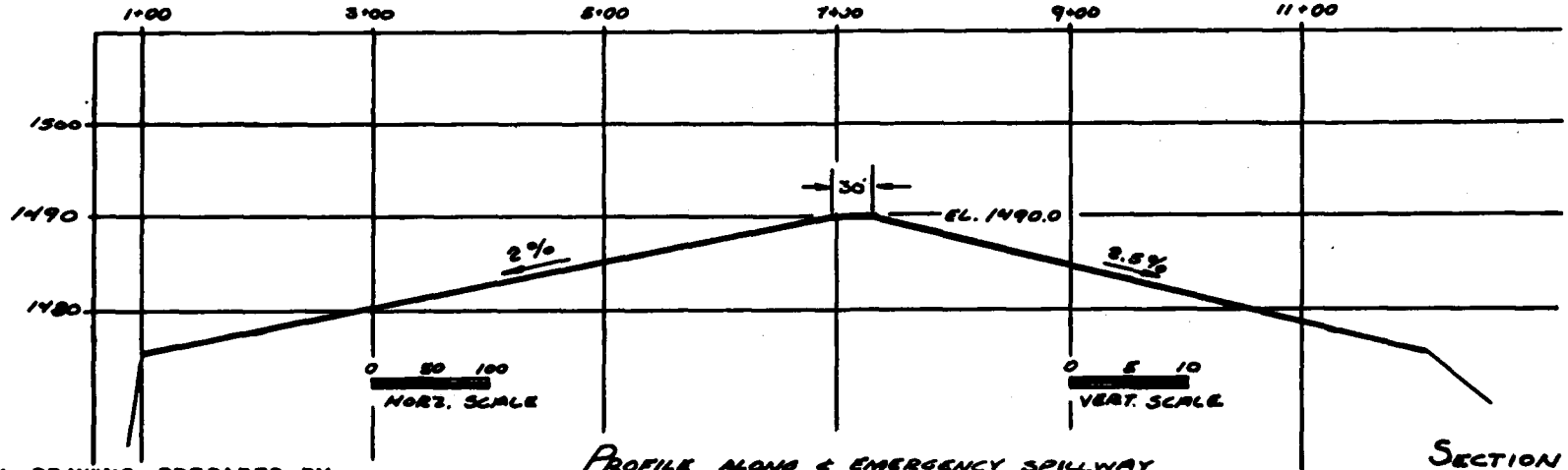
National Dam Inspection Program
Jewell Brook Watershed
Dam Site No. 5
Ludlow, Vermont
Plan and Section Views

JAS	2/80
TMC	9114
8-2	



PROFILE ALONG ℄ EMERGENCY SPILLWAY
LEFT SIDE

SECTION C-C



PROFILE ALONG ℄ EMERGENCY SPILLWAY
RIGHT SIDE

SECTION B-B

ORIGINAL DRAWING PREPARED BY
USDA SOIL CONSERVATION SERVICE 1970

DuBois & King Inc.
engineering and environmental services
RANDOLPH VERMONT · CONCORD NEW HAMPSHIRE

Department of the Army
New England Division
Corps of Engineers
Waltham, MA 02154

National Dam Inspection Program
Jewell Brook Watershed
Dam Site No. 5
Ludlow, Vermont
EMERGENCY SPILLWAY PROFILES

DRAWN BY	DATE
JAS	2/80
CHECKED BY	PROJ. NO.
	9111-4
PROJ. ENG.	DRWG. NO.

EXHIBIT

APPENDIX C

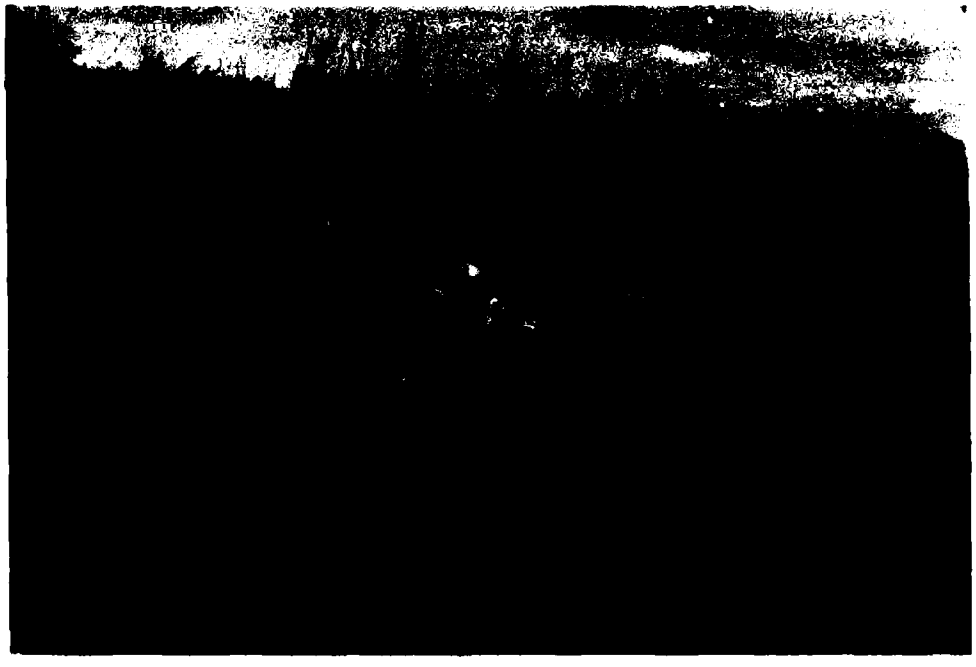
PHOTOGRAPHS

FOR LOCATION OF PHOTOS, SEE FIGURE B-1
LOCATED IN APPENDIX B

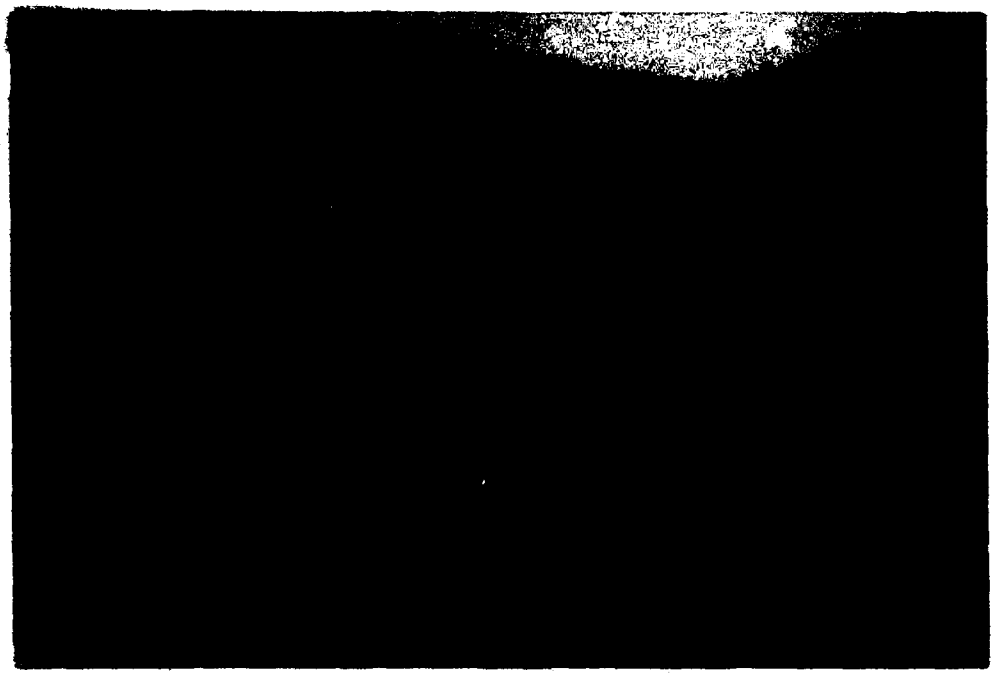
#1 DOWNSTREAM FACE FROM LEFT ABUTMENT

#2 DOWNSTREAM FACE LOOKING UPSTREAM

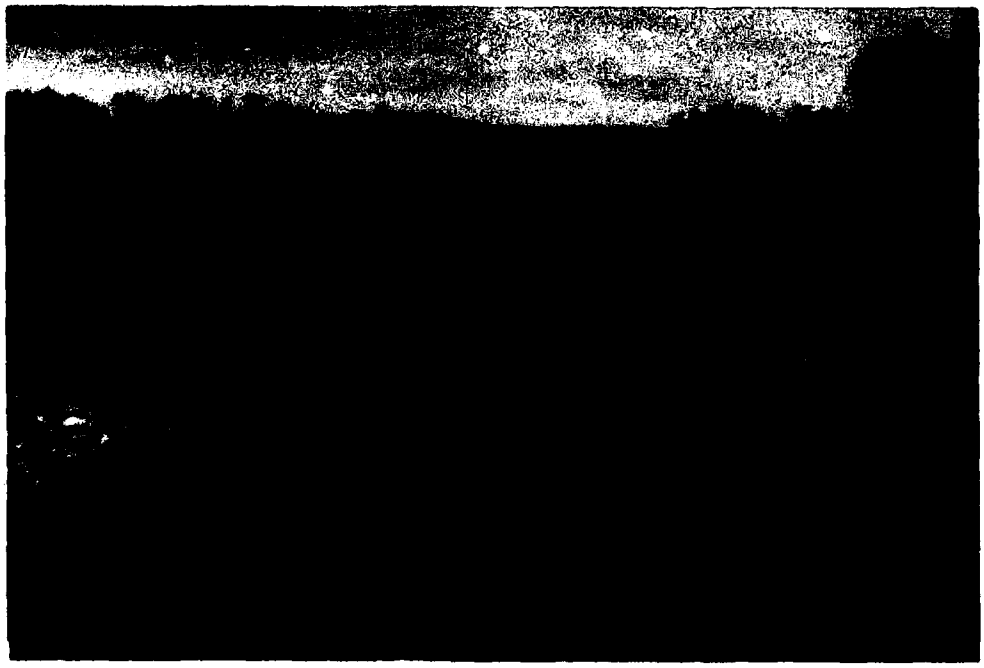
#3 UPSTREAM FACE FROM LEFT ABUTMENT



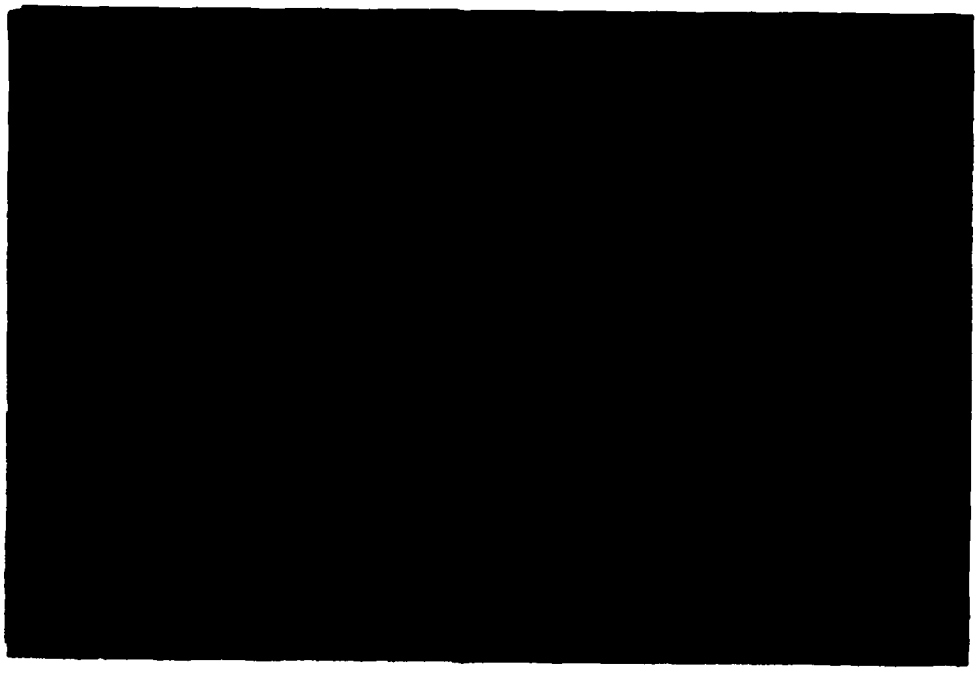
#4 CREST DRAIN



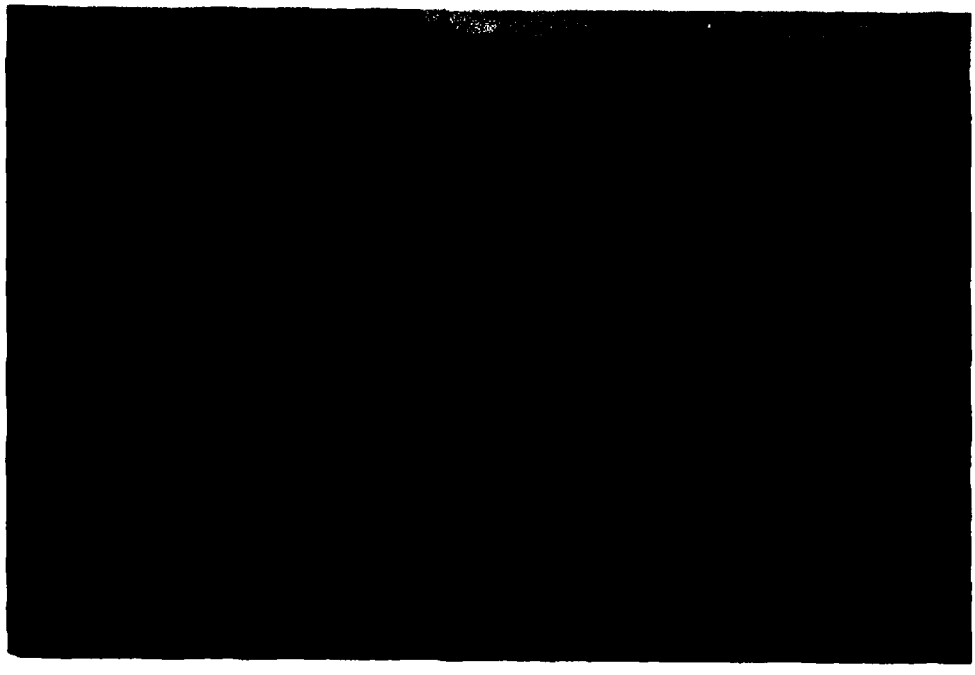
#5 VEHICULAR TRACKS NEAR DOWNSTREAM LEFT ABUTMENT CONTACT LINE



#6 TRESPASSING ALONG SLOPE OF LEFT ABUTMENT
AND SPILLWAY TRAINING DIKE



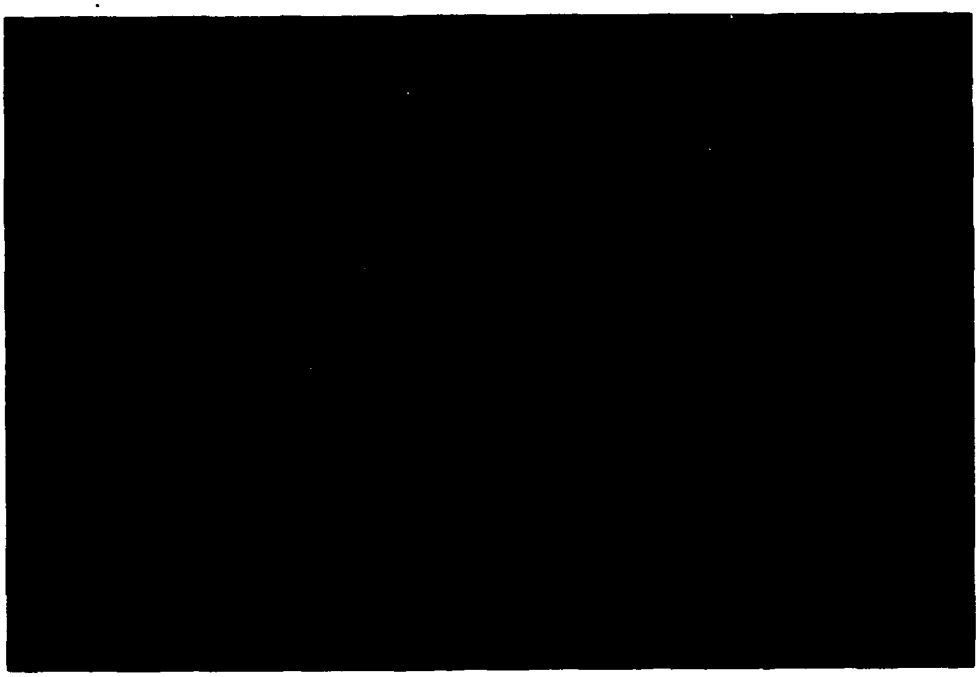
#7 LOOKING FROM RIGHT TO LEFT ALONG CREST



#8 ROAD ACROSS LEFT EMERGENCY SPILLWAY

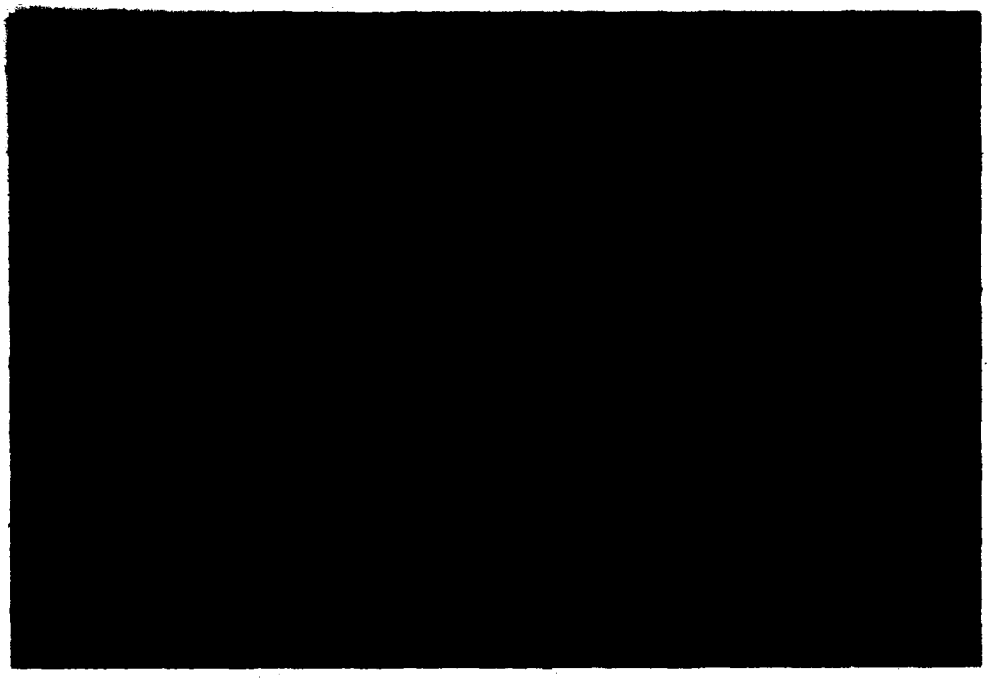
#9 LEFT EMERGENCY SPILLWAY LOOKING UPSTREAM

#10 LOOKING FROM RIGHT ABUTMENT ACROSS RIGHT EMERGENCY SPILLWAY AND DAM CREST

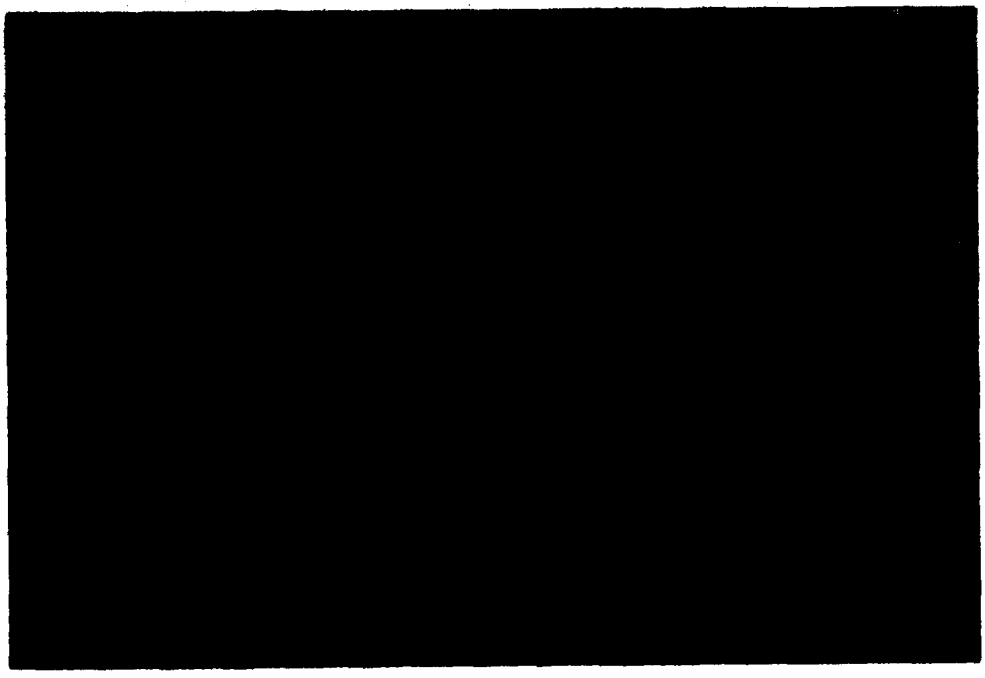


#11 VEHICULAR TRACKS ALONG DOWNSTREAM PORTION OF RIGHT EMERGENCY SPILLWAY

#12 RIGHT EMERGENCY SPILLWAY LOOKING UPSTREAM



#13 DEPRESSION IN RIGHT BANK OF RIGHT EMERGENCY SPILLWAY BELOW INTERCEPTOR DRAIN

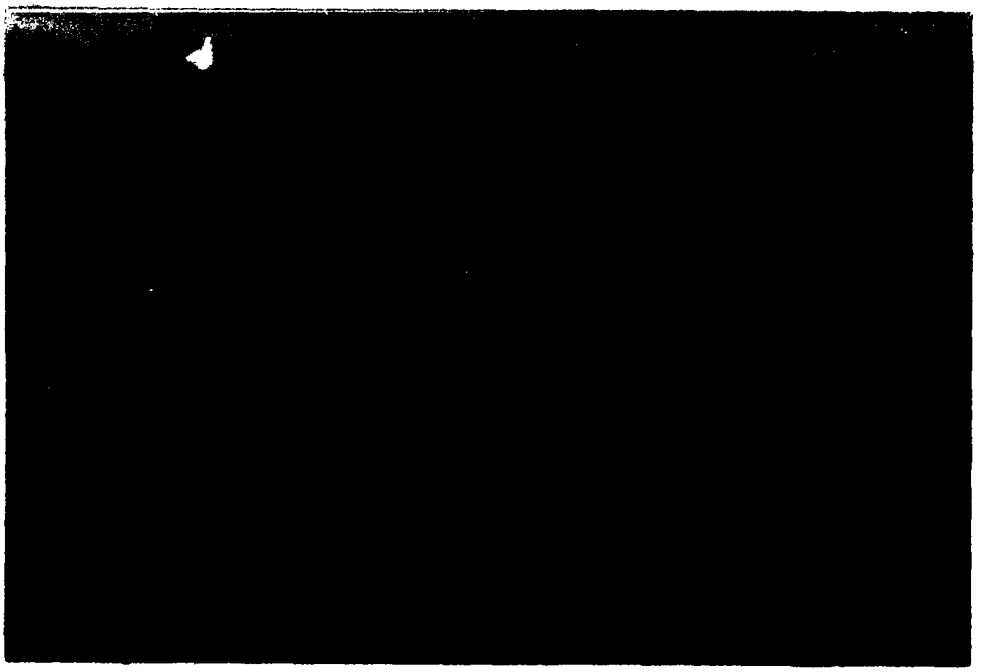


#14 INTERCEPTOR DRAIN ALONG RIGHT ABUTMENT WALL

#15 EROSION AT TOP OF RIGHT BANK DIVERSION CHANNEL

#16 RIGHT BANK DIVERSION CHANNEL FOR INTERCEPTOR DRAIN

#17 DOWNSTREAM TOE AND DIKE AREA OF RIGHT EMERGENCY SPILLWAY

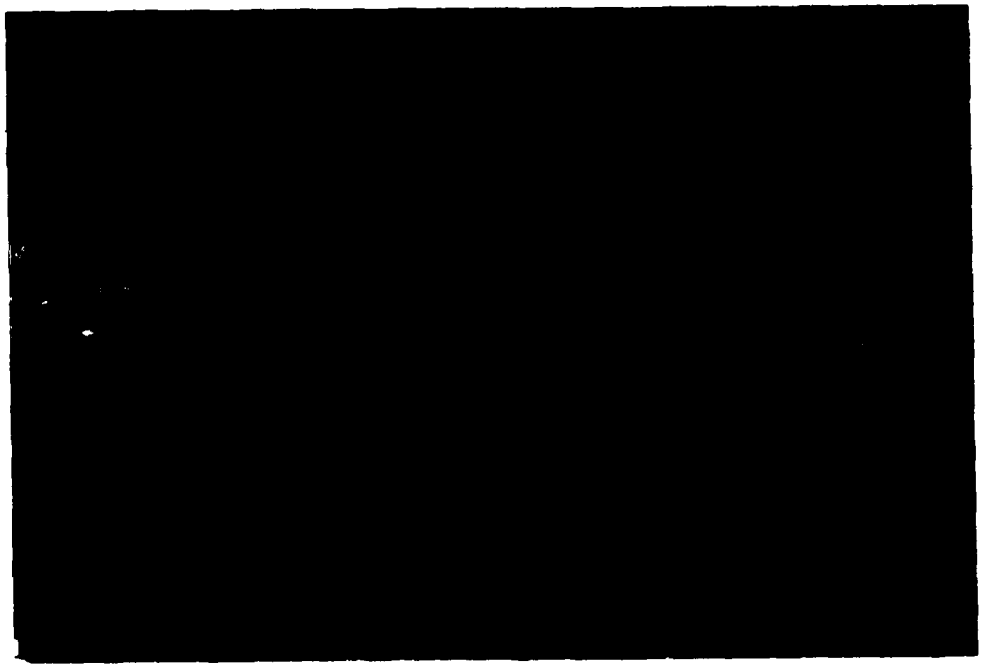


#18 PRINCIPAL SPILLWAY WEIR STRUCTURE

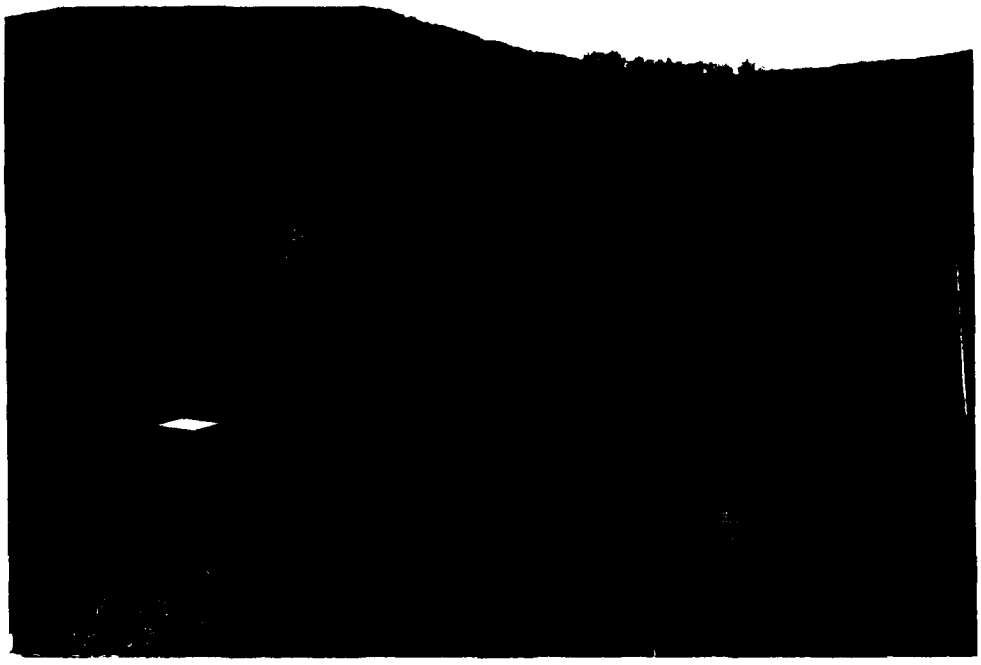
#19 PRINCIPAL SPILLWAY OUTFALL AND PLUNGE POOL

#20 PLUNGE POOL LOOKING DOWNSTREAM

#21 TOE DRAIN AND COVERED GAGE TO THE RIGHT OF
THE PRINCIPAL SPILLWAY OUTFALL



#22 TWO TOE DRAINS TO THE LEFT OF THE PRINCIPAL SPILLWAY OUTFALL



#23 RESERVOIR AREA

#24 DOWNSTREAM CHANNEL

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Job No. 9111 4 Sheet 1 of 24
Project Jewell Brook #5 Date 2/7/80
Subject Basic Data By PMC Ch'k. by

SCS data examined for validity

1) DRAINAGE AREA = 1.74 $mi.^2$ = 1114 acres - OK

2) AREA, VOLUME VS ELEVATION CURVES, SCS values checked, plotting checked, (refer to pages 2-6)

3) Rating Curve - SCS data checked, rating curve plotted (Refer to pages 7-13)

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Area Computations

PROJECT Jewell Brook Site #5 TYPE OF COMPUTATION Stage - Storage

PLANIMETERED FROM Plan View BY C. Foster & JRG DATE 11/67

PLANIMETER NUMBER 701RS MAP NO. _____ CHECKED BY R.H.B. DATE 12/67

PLANIMETER CONSTANT 1.000 MAP SCALE 1" = 100' 1 Sq. In. = 0.2295 AC. _____ SQ. _____

Map or Area	Contour	Elevation or Cross Sec.	Planimeter Readings: Initial	First Run	Second Run	Third Run	Area in Planimeter Units: A 1	A 2	A 3	Mean Area in Planning Units	Area (Ac)	Ac. Ft Volume	Ac. Ft Volume (Accum)
		1426	0.00							0.00	0		
	2											0.018	0.018
		1428	0.00	0.08	0.16		0.08	0.08		0.08	0.018		
	4											0.384	0.402
		1432	0.69	1.45	2.21		0.76	0.76		0.76	0.174		
	4											1.110	1.512
		1436	1.98	3.65	5.60		1.67	1.65		1.66	0.381		
	4											1.938	3.450
		1440	5.05	7.62	10.17		2.57	2.55		2.56	0.588		
	4											3.366	6.816
		1444	0.28	5.05	9.89	14.60	4.77	4.84	4.71	4.77	1.095		
	4											5.156	11.972
		1448	3.77	10.27	16.70	23.15	6.50	6.43	6.45	6.46	1.483		
	4											6.660	18.632
		1452	7.21	15.32	23.37	31.37	8.11	8.05	8.00	8.05	1.847		
	4											8.026	26.658
		1456	1.09	10.47	19.93	29.43	9.38	9.46	9.47	9.44	2.166		
	4											9.680	36.338
		1460	9.60	21.25	32.89		11.65	11.64		11.65	2.674		
	4											12.018	48.356
		1464	1.00	15.60	30.10	44.60	14.60	14.50	14.50	14.53	3.335		
	4											15.144	63.500
		1468	43.76	62.30	80.75	99.14	18.54	18.45	18.39	18.46	4237		

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Area Computations

PROJECT JEWELL BLOCK SITE #5 TYPE OF COMPUTATION STAGE - STORAGE

PLANIMETERED FROM PLAN VIEW BY CAF & JRG DATE 11/67

PLANIMETER NUMBER 701K3 MAP NO. CHECKED BY R.N.B. DATE 12/67

PLANIMETER CONSTANT 1.000 MAP SCALE 1" = 1H' 1 Sq. In. = 0.2295 AC. SQ.

Map or Area	Vert.	Elevation or Cross Sec.	Planimeter Readings Initial	First Run	Second Run	Third Run	Area In Planimeter Units A 1	A 2	A 3	Mean Area in Planning Units	Area (Ac)	Ac. Ft Volume	Accum
	0	1468	43.76	62.30	80.75	99.14	18.54	18.45	18.39	18.46	4.237		
	4											18.600	82.100
		1472	2.50	24.57	46.62		22.07	22.05		22.06	5.063		
	4											21.592	103.692
		1476	7.73	27.79	52.74	77.66	23.06	24.95	24.92	24.98	5.733		
	4											24.992	128.684
		1480	23.58	53.02	82.43	111.59	29.44	29.41	29.56	29.47	6.763		
	4											29.682	158.366
		1484	17.72	52.80	87.10	123.32	35.08	35.30	35.22	35.20	8.078		
	4											35.920	194.286
		1488	25.71	68.70	111.90	154.90	42.99	43.20	43.00	43.06	9.882	20.882	215.168
	2											21.013	215.299
		1490	69.10	117.33	165.18	212.90	48.23	47.85	47.72	47.93	11.000		
	2												238.474
		1492	83.57	136.70								23.306	238.605
				50.01	104.00	151.54	53.33	53.99	53.54	53.62	12.306		289.690
	4											51.216	289.821
		1496	26.12	84.11	142.60	200.01	57.99	58.49	57.41	57.96	13.302		

USDA-SCS-HYATTSVILLE, MD. 1969

3 of 2

SCS-344a 5-57
Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD WATER STORAGE AC-FT

CH. 2 H.R. 12/6

ADJUSTED SED = 0.462 AC-FT PER FOOT OF ELEV.

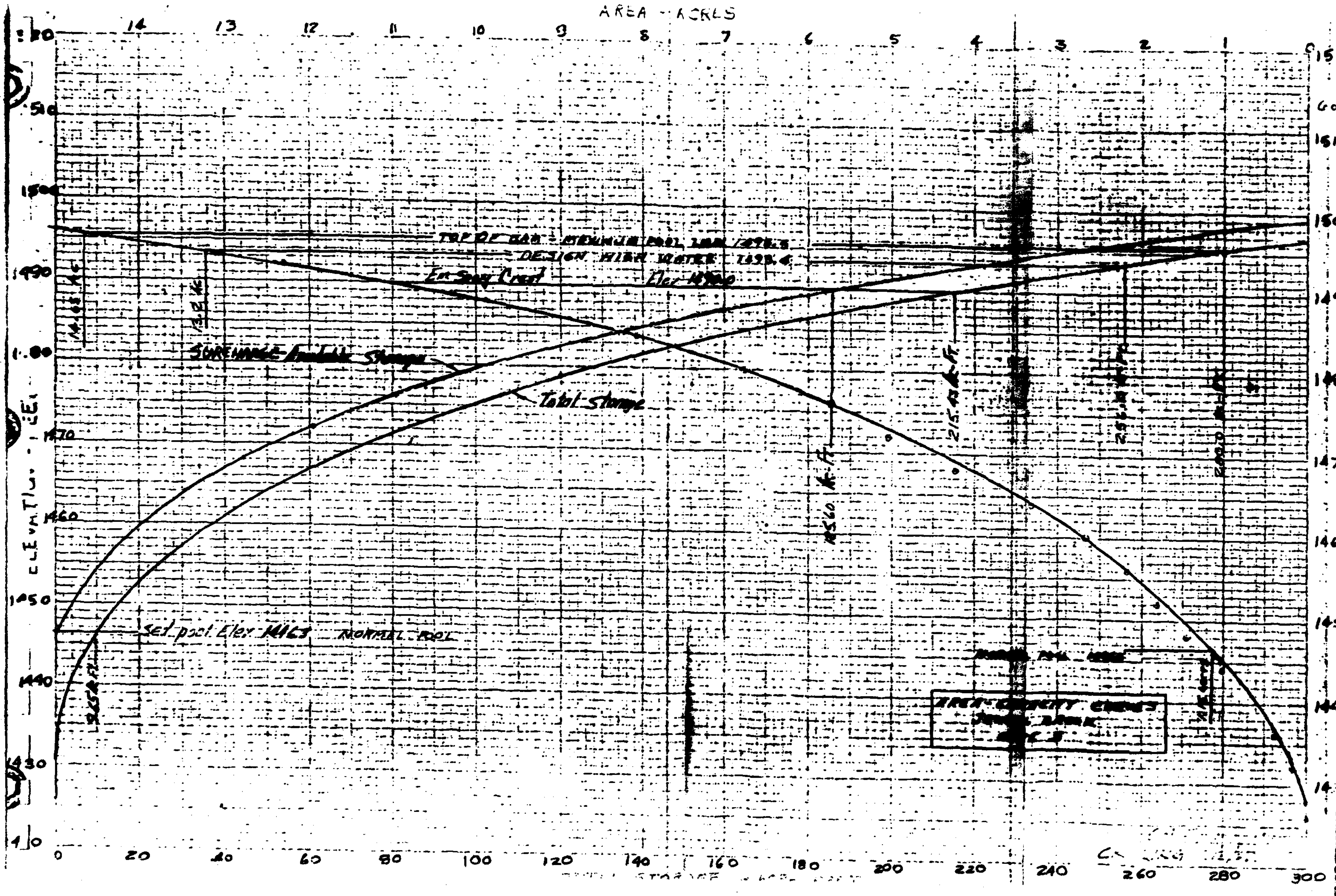
BETWEEN ELEV 1446.3 AND 1490.0

ELEV.	TOTAL STORAGE	TOTAL STORAGE - SUSP. SED	ADJUSTED SED	TOTAL AVAIL. STORAGE				
1446.3	9.65	—	—	—				
1448	11.97	2.32	0.79	1.53				
1452	18.63	8.98	2.63	6.35				
1456	26.66	17.01	4.48	12.53				
1460	36.34	26.69	6.33 6.32	20.36 20.37				
1464	48.36	38.71	8.18 8.16	30.53 30.55				
1468	63.10	53.65	10.03	43.62				
1472	82.10	72.45	11.87	60.58				
1476	103.65	94.04	13.72	80.32				
1480	128.68	119.03	15.57	103.46				
1484	158.37	149.72	19.42	131.30				
1488	194.29	184.64	19.27	165.37				
1490	215.17	205.52	20.19	185.33				

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

3. FLOOD WATER STORAGE AC-FT JEG 7/67

1492	238.47	229.62	21.11	207.71				
1496	289.76	280.04	22.96	257.08				



AREA - ACRES
TOP OF DAM
DESIGN HIGH WATER 1493.4
Em Spwy Crest
Elev 1490.0
SURCHARGE Available Storage
Total Storage
Sed pool Elev 1446.3 NORMAL POOL
ELEVATION - FEET
AREA-CAPACITY CURVES

Job No. 91114 Sheet 7 of 24
Project Jewell Brook #5 Date 2/7/80
Subject Basic Data By PMC Ch'k. by

Jewell Brook Dam Site #5 - Located in Ludlow, VT

CLASSIFICATION : SIZE - LARGE (Based upon height)

HAZARD - HIGH (Based upon numerous downstream homes)

Basic data :

Drainage area = 1.74 mi^2 = 1114 acres

RESERVOIR : NORMAL POOL LEVEL - 1446.3'
Area - 1.15 acres
STORAGE - 9.65 a-f

DESIGN HIGH WATER - 1493.4'
Area - 13.2 acres
STORAGE - 256.0 a-f

MAXIMUM POOL LEVEL (TOP OF DAM) 1496.6'
Area - 14.65 acres
STORAGE - 280 a-f

DAM: Earthfill with zoning, side slopes US 3:1
HEIGHT - 112.7'
DS 2.5:1
LENGTH - 650'

PRINCIPAL SPILLWAY : STD SCS RISER 2.5' x 7.5'
30"ϕ RCP OUTLET
NOTE: LOW LEVEL RISER MAKES ORIFICE UNNECESSARY

EMERGENCY SPILLWAY : TWO 150' WIDE Earth SPILLWAYS (Vegetation covered)

Job No. 91114 Sheet 8 of 24
Project Jewell Brook #5 Date 2/7/80
Subject Hydrology By RMC Ch'k. by

STEP 1 CHOOSE TEST FLOOD

SIZE- LARGE

HAZARD- HIGH

DAM SAFTEY GUIDELINES RECOMMEND

FULL PMF

ENTER PMF CURVE ENVELOPE

BASIN MOUNTAINOUS, DA = 1.74 mi^2, as per COE advice, smallest Drainage Area on Curve used (2 mi^2)
Resulting cfs/mi^2 multiplied by DA to obtain PMF

PMF - 2550 cfs/mi^2

PMF = 2550 cfs/mi^2 x 1.74 mi^2 = 4437 cfs say 4500 cfs

TEST FLOW = 4500 cfs

STEP 2 RATING CURVE

SCS RATING CURVE DATA CHECKED AND
RE PLOTTED

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE		PROJECT		
VT		Lowell Brook		
BY	DATE	CHECKED BY	DATE	JOB NO.
PGK	11/29/67	JKG	1/31/68	Site #5

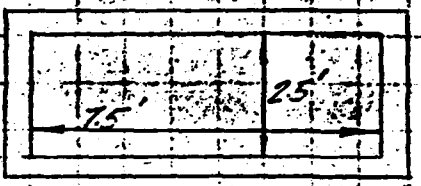
SUBJECT: Discharge Constants — SHEET 9 OF 24

Weir Flow

$Q = CLH^{3/2}$

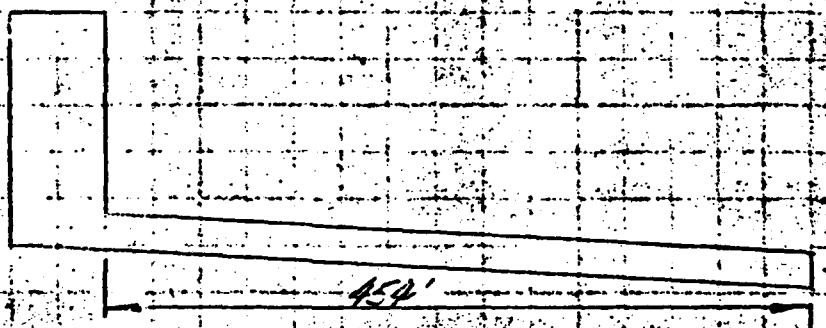
$= 3.1(15.0)H^{3/2}$ ✓OK

$= 46.5\,H^{3/2}$



C = 3.1 (Eaq Memo 50)

Pressure Flow in Conduit



$Q = a\sqrt{\frac{2gH}{1 + K_c + K_p L_p}}$

$= 4.91\left[\frac{64.4}{1 + 1.0 + 0.00786(454)}\right]^{1/2} H^{1/2}$ ✓OK

$= 16.70\,H^{1/2}$

30" ϕ RCP
n = 0.012
$K_p = 0.00786$ (ES-4)
$a = 4.91$ sq ft
$K_c = 1.0$
L = 454'
$g = 32.2$ ft/sec²

COMPUTATION SHEET
SCS-522 REV 5-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GPO 1958 O—

STATE		PROJECT		
VT.		Jewell Brook		
BY	DATE	CHECKED BY	DATE	JOB NO.
PJC	12/7/67	JKG	1/3/68	Site 5

SUBJECT: Emergency Spillway Discharge — SHEET 10 OF 20

Two Spwy's each 150' wide, L = 500' & 200'
b = 150' n = 0.04 30' Level Section Z = 3
Em Spwy Crest El. 1490.0'
Ref TP-25 Ec-612 Lds

← L = 500' → ← L = 200' →

Hp	Q/b	Q cfs	Q/b	Q cfs	Q Total	Elc
0.5	0.53	80	0.56	84	164	1490.5
1.0	1.77	266	1.88	282	548	1491.0
2.0	5.80	870	6.10	915	1785	1492.0
3.0	12.2	1830	12.5	1875	3705	1493.0
4.0	20.2	3030	20.6	3090	6120	1494.0
5.0	30.0	4500	30.8	4620	9120	1495.0
6.0	41.3	6195	42.2	6330	12525	1496.0

OK

SCS-347 5-57
Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

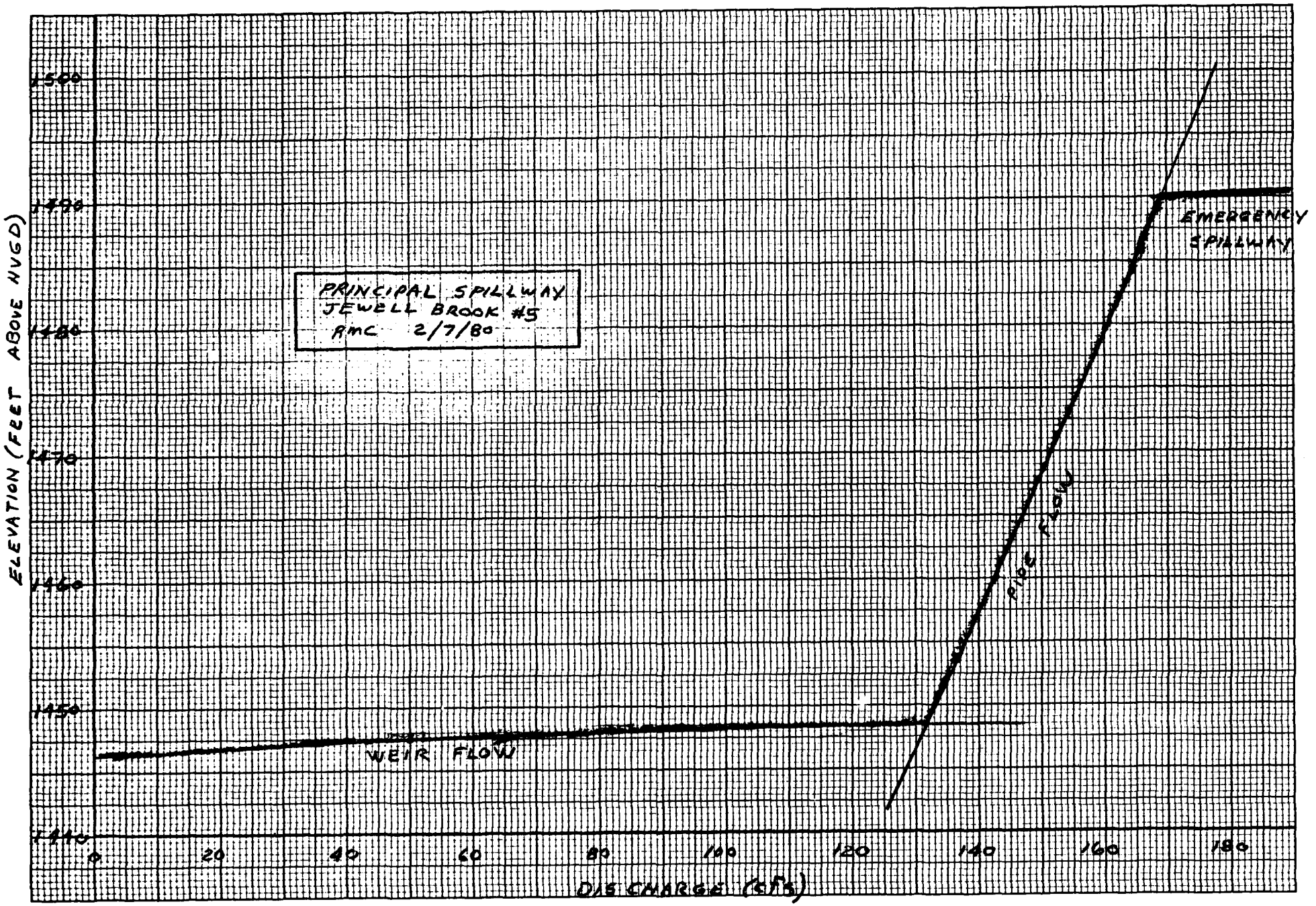
Jewell Brook Site #5

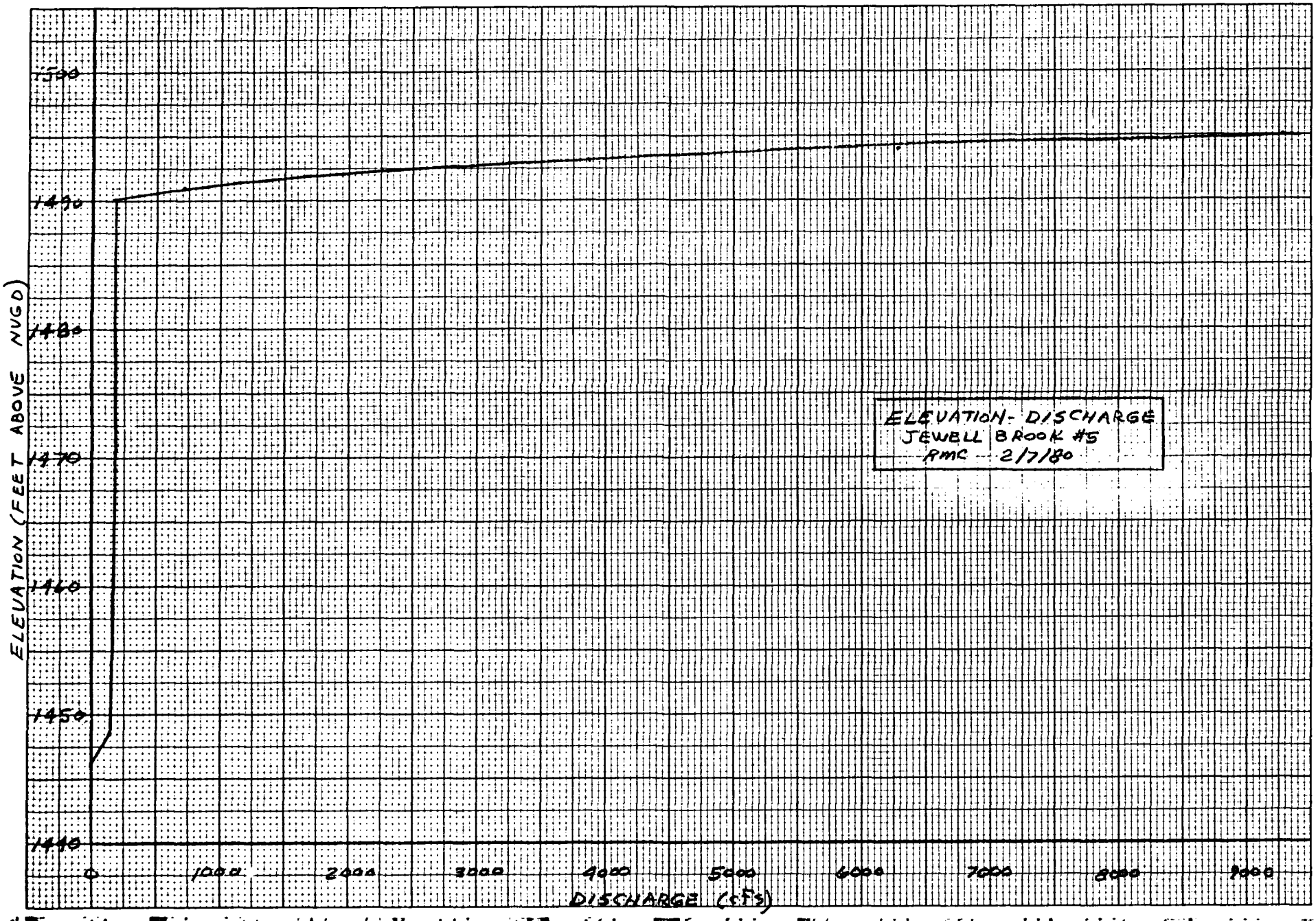
Stage-Discharge Computations Pipe Outlet

JCG 1-3-67

	Elev	Weir		Conduit		E. Spwy		Total
		H_w	$Q_w = 3.5 L H^{3/2}$	H_c	$Q_c = K_{30} H^{1/2}$	H_e	Q_e	Q_T
Riser Crest	1486.3	0	0					0
	1486.8	0.5	16.5					16.5
	1487.3	1.0	46.5					46.5
	1487.8	1.5	85.3	61.0	130.5			85.3
	1488.3	2.0	131.5	61.5	131.0			131
	1450.0			63.2	133			133
	1460.0			73.2	143			143
	1470.0			83.2	152			152
	1480.0			93.2	161			161
E. Spwy Crest	1490.0			103.2	169	0	0	169
	1491.0			104.2	170	1.0	548	718
	1492.0			105.2	171	2.0	1785	1956
	1493.0			106.2	172	3.0	3705	3877
	1494.0			107.2	173	4.0	6120	6293
	1495.0			108.2	174	5.0	9120	9294
	1496.0			109.2	175	6.0	12.525	12700

Pipe outlet @ Elev. 1486.8





Job No. 91114 Sheet 14 of 24
Project Jewell Brook #5 Date 2/7/80
Subject Hydraulics / Hydrology By RMC Ch'k. by

STEP 3 EFFECT OF SURCHARGE STORAGE ON PMF

Q_{P_1} = 4500 cfs SURCHARGE ELEVATION$_1$ = 1493.5' (see rating curve, page 13)

$STOR_1$ = SURCHARGE VOLUME (see curve, page 6)

@ Elevation 1493.5', surcharge volume = 256.0 a-f

$$STOR_1 = \frac{256.0 \text{ a-f} \times 12''/\text{ft}}{1117 \text{ acres}} = 2.7576''$$

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{STOR_1}{19''}\right) = 4500\left(1 - \frac{2.7576}{19}\right) = 3847 \text{ cfs}$$

SURCHARGE ELEVATION$_2$ = 1493.2'

$STOR_2$ = 252.0 a-f

$$STOR_2 = \frac{252.0 \times 12}{1114} = 2.7145''$$

$$STOR_{ave} = (2.7145 + 2.7576)/2 = 2.7361''$$

$$Q_{P_3} = 4500\left(1 - \frac{2.7361}{19}\right) = 3852 \text{ cfs}$$

SURCHARGE ELEVATION$_3$ = 1493.2'

SURCHARGE ELEVATION$_3$ = SURCHARGE ELEVATION$_2$ = 1493.2'
NO FURTHER ITERATIONS NECESSARY, VALUES WILL NOT CHANGE SIGNIFICANTLY

CONCLUSIONS

1) RESERVOIR STORAGE WILL REDUCE THE TEST INFLOW OF 4500 cfs TO AN OUTFLOW OF 3852 cfs, OR BY 14%.

2) THE SPILLWAYS CAN PASS 100% OF THE ROUTED TEST FLOOD DISCHARGE W/O DAM OVERTOPPING OCCURING.

3) THE DAM WILL HAVE A FREE BOARD OF 2.3 FEET (WATER SURFACE ELEVATION OF 1493.2') WHEN THE TEST FLOOD IS ROUTED.

Job No. 91114 Sheet 15 of 24
Project Jewell Brook #5 Date 2/7/80
Subject Hydrology By RMC Ch'k. by

DOWNSTREAM DAMAGE ESTIMATE

STEP 1 RESERVOIR CAPACITY - WATER SURFACE ASSUMED AT CREST OF EMERGENCY SPILLWAY (EL. 1490.0)

STORAGE = 215.4 a-f

STORAGE AT TEST FLOOD ELEVATION - 261.7 a-f

STEP 2 PEAK FAILURE OUTFLOW "SUNNY DAY FAILURE"

$$Q_{P_1} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$$

W_b = up to 40% of dam width

Y_o = height from pool level to upstream invert = 1490.0' (Emergency spillway crest) - 1426.5' (US invert)

Y_o = 63.5'

Reasonable assumption for breach width would be less than 40% of 650' width, or 260'. Better assumption would be 10% of dam width, or 65'. this approximates a rectangular channel with at TW of 65' and 106' deep

Ref. Evaluation of Dam Saftey, ASCE, 1976, A 445

$$Q_{P_1} = \frac{8}{27} (0.10) 650 \sqrt{32.2} (63.5)^{3/2}$$

$$Q_{P_1} = 155,300 \text{ cfs}$$

"DAM FAILURE DURING TEST FLOOD ANALYSIS"

$$Q_{P_2} = \frac{8}{27} (0.10) 650 \sqrt{32.2} (66.7)^{3/2}$$

(Y_o: test Flood elev 1493.2 - 1426.5)

Y_o = 66.7'

$$Q_{P_2} = 59,533 \text{ cfs}$$

at test flood elevation of 1493.2', base flow (Dam discharge) = 3852 cfs

FLOW TO BE ROUTED IS SUM OF TWO

$$Q_{P_2} = 59,533 + 3852 = 63,385 \text{ cfs} \approx 63,400 \text{ cfs}$$

Job No. 91114 Sheet 16 of 24
Project Jewell Brook #5 Date 2/7/80
Subject Hydraulics By PMC Ch'k. by

STEP 3 DEVELOP DOWNSTREAM RATING CURVES FOR CHANNEL ROUTING

SAUNDERS BROOK - To confluence w/Jewell Brook

CHARACTERISTICS

$L = 2200'$

$\Delta elev = 1383.9 - 1260$

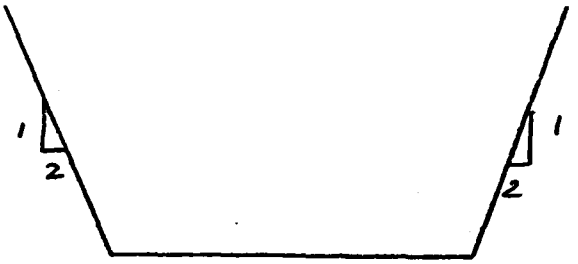
$\Delta elev = 123.9'$

$S = \frac{123.9'}{2200'} = 0.05632'/'$

$n = 0.045$, woods, stone channel

* Refer USBR, Hydraulic and Excavation Tables

XS Approximated from USGS Mapping

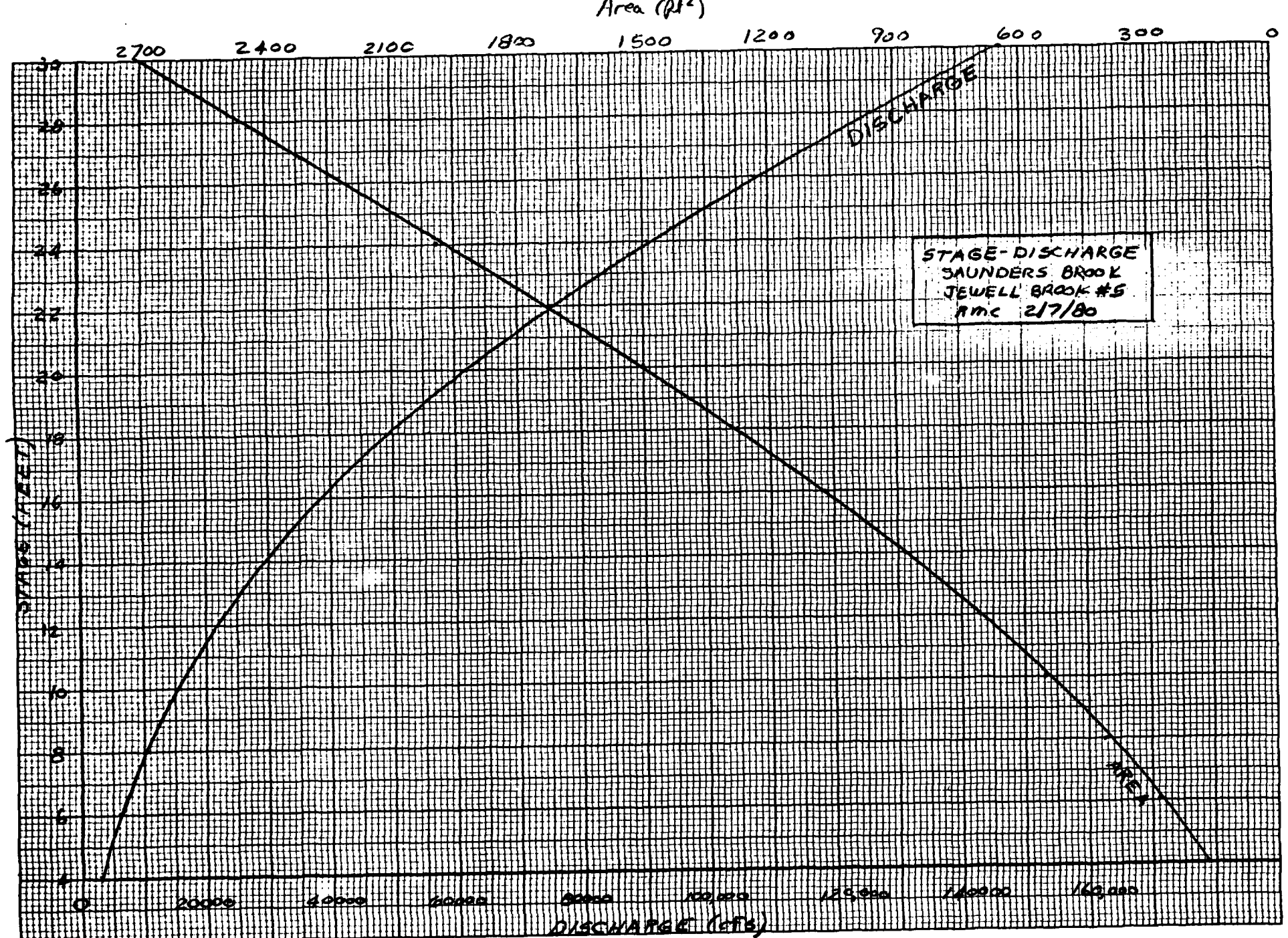


Normal Flow Found via Mannings Equation

$\Phi = \frac{1.49}{n} A R^{2/3} S^{1/2}$

STAGE (ft)		AREA * (ft^2)	HYDRAULIC RADIUS * (ft)		FLOW (cfs)
2		78	1.77		897
4		172	3.25		2965
6		282	4.56		6093
8		408	5.76		10,302
10		550	6.90		15,664
12		708	7.99		22000
14		882	9.04		29500
16		1072	10.06		38500
18		1278	11.07		49200
20		1500	12.05		61,951
22		1738	13.03		75,621
24		1992	14.00		90923
26		2262	14.95		107866
28		2548	15.90		126,599
30		2850	16.85		147,189

46 1320



Job No. 91114 Sheet 16 of 24
Project Jewell Brook #5 Date 2/6/80
Subject Hydraulics By RMC Ck'd. by

REACH 2 - Jewell Brook

confluence w/ Saunder's Brook thru Village of Ludlow

CHARACTERISTICS

$L = 6800'$

$\Delta elev = 1260 - 1020$

$\Delta elev = 240'$

$S = \frac{\Delta elev}{L} = \frac{240'}{6800'}$

$S = 0.03529'/'$

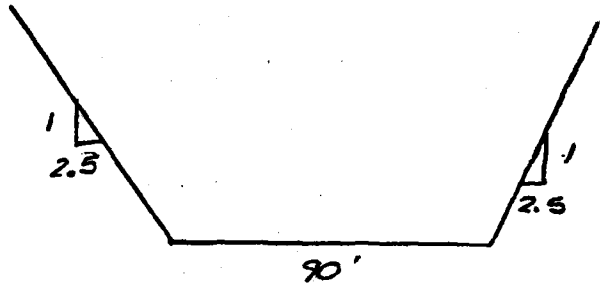
$n = 0.04$, fields, small scrub,

* Refer- USBR Hydraulic and Excavation Tables

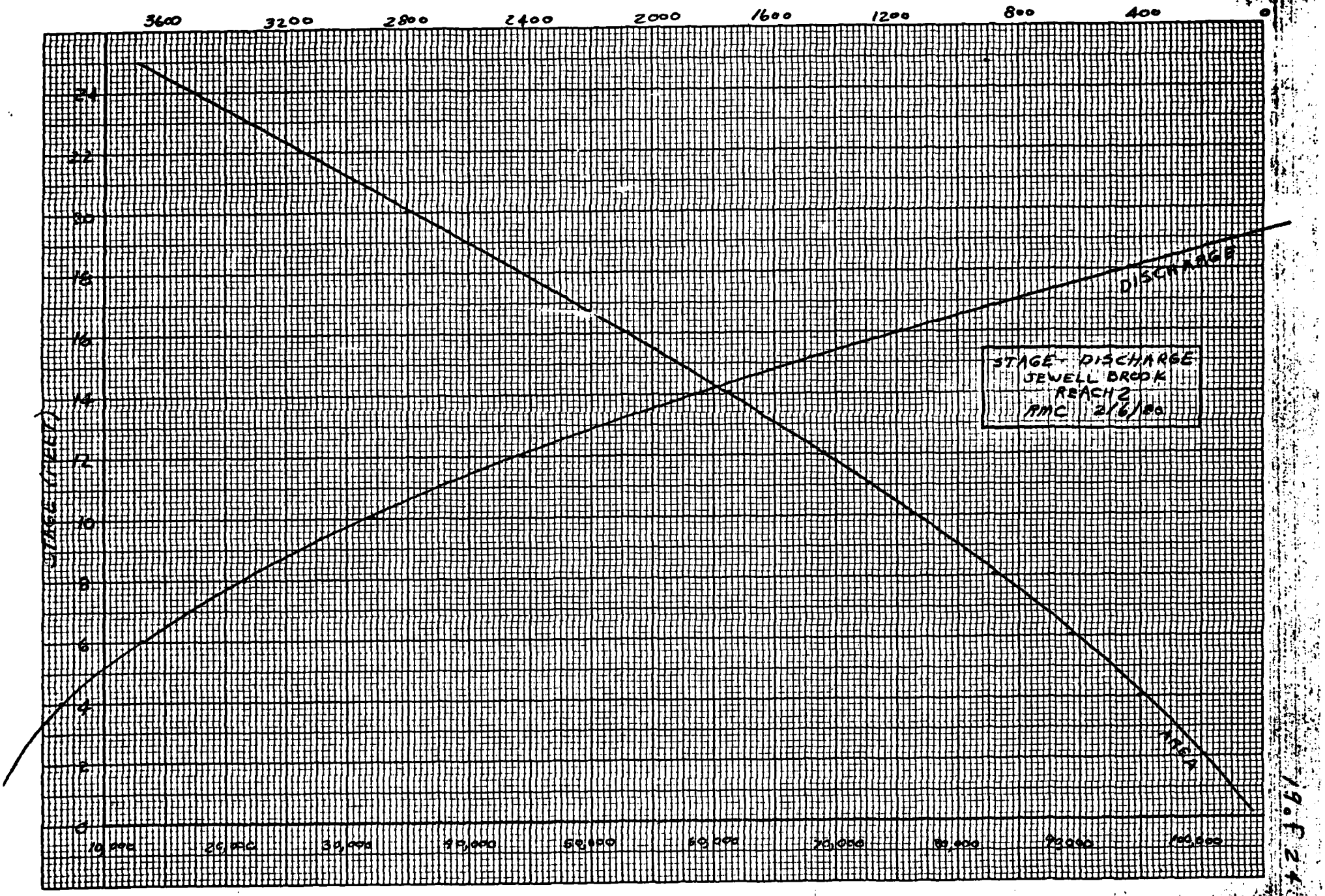
Normal flow computed via Mannings Equation

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

XS Approximated from USGS Mapping



STAGE (ft)		AREA* (ft^2)	HYDRAULIC RADIUS* (ft)		FLOW (cfs)
2		190.0	1.89		2033
4		400.0	3.59		6563
6		630.0	5.15		13148
8		880.0	6.61		21690
10		1150.0	7.99		32,164
12		1440.0	9.31		44,697
14		1750.0	10.58		59,021
16		2080.0	11.81		75 487
18		2430.0	13.00		94 018
20		2800.0	14.16		114,686



Job No. 91114 Sheet 20 of 24
Project Jewell Brook #5 Date 2/25/80
Subject Channel Routing By RMcC Ch'k. by

STEP 4 "SUNNY DAY" DAM BREACH ROUTING

Q_{P_1} = 55,300 cfs stage = 19.0' area = 1395 □'

ENTER SAUNDERS BROOK

$V_1 = \frac{2200' \times 1395\ \square'}{43560\ \square'/acre} = 70.5$ a-f < $\frac{215.4}{2}$ a-f ∴ L is O.

L_1 = 2200'

$Q_{P_{trial}} = Q_{P_1}(1 - \frac{V_1}{S}) = 55,300\ (1 - \frac{70.5}{215.4}) = 37,212$ cfs

stage = 15.7' area = 1050 □'

$V_2 = \frac{1050\ \square' \times 2200'}{43560\ \square'/acre} = 53.0$ a-f

$V_{ave} = (70.5 + 53.0)/2 = 61.8$ a-f

$Q_{P_2} = 55,300\ (1 - \frac{61.8}{215.4}) = 39,443$ cfs ≈ 39,500 cfs

OUTFLOW = 39,500 cfs STAGE = 16.1'

ENTER JEWELL BROOK REACH 2

stage = 11.4' area = 1340 □'

$V_1 = \frac{1340\ \square' \times 6800'}{43560\ \square'/acre} = 209.2$ a-f > $\frac{215.4}{2}$ a-f

Reach length is too Long

L_2 = 6800'

$L = \frac{1}{1340\ \square'} \times 43560\ \square' \times \frac{215.4}{2}$ a-f = 3501'

use 3500'

$V_1 = \frac{1340\ \square' \times 3500'}{43560\ \square'} = 107.7$ a-f < $\frac{215.4}{2}$ a-f

L is OK

Job No. 9114 Sheet 21 of 24
Project Jewell Brook #5 Date 2/25/80
Subject Channel Routing By PMC Ch'k. by

$Q_{P_{trial}} = 39,500 \left(1 - \frac{107.7}{215.4}\right) = 19,756$ cfs

$\frac{6800}{-3500}$, $\frac{}{3300'}$

stage = 7.7' area = 820 □'

$V_2 = \frac{820\ \square' \times 3600'}{43560} = 65.9$ a-F

$V_{ave} = (65.9 + 107.7)/2 = 86.8$ a-F

$Q_{P_2} = 39,500 \left(1 - \frac{86.8}{215.4}\right) = 23,584$ cfs

stage = 8.5' area = 930 □'.

$V_1 = \frac{930\ \square' \times 3300'}{43560\ \square'} = 70.5$ a-f $< \frac{215.4}{2}$ a-F

$Q_{P_{trial}} = 23684 \left(1 - \frac{70.5}{215.4}\right) = 15870$ cfs

stage = 6.7' area = 700 □'

$V_2 = \frac{700\ \square' \times 3300'}{43560} = 53.0$ a-f

$V_{ave} = (70.5 + 53.0)/2 = 61.8$ a-F

$Q_{P_2} = 23,584 \left(1 - \frac{61.8}{215.4}\right) = 16,818$ cfs $\approx 17,000$ cfs

OUTFLOW = 17,000 cfs STAGE = 7.0'

ROUTE DAM BREACH DURING TEST FLOOD

ENTER SAUNDERS BROOK

$Q_{P_1} = 63,400$ cfs stage = 20.2' area = 1530 □'

$V_1 = \frac{2200' \times 1530\ \square'}{43560\ \square'/\text{acre}} = 77.3$ a-f

$L_1 = 2260'$

77.3 a-F $< \frac{261.7}{2}$ a-F $\therefore$ L is OK

Job No. 91114 Sheet 22 of 24
Project Jewell Brook #5 Date 2/25/80
Subject Channel Routing By fmc Ch'k. by

$Q_{P\,trial} = 63,400 \left(1 - \frac{77.3}{261.7}\right) = 44,679$ cfs

stage = 17.2' area = 1200 □'

$V_2 = \frac{1200\ \square' \times 2200'}{43560\ \square'/acre} = 60.6$ a-f

$V_{ave} = (77.3 + 60.6)/2 = 68.9$ af

$Q_{P_2} = 63,400 \left(1 - \frac{68.9}{261.7}\right) = 46,695$ cfs ≈ 46700 cfs

OUTFLOW: 46,700 cfs STAGE: 17.6'

ENTER JEWELL BROOK - REACH 2

$Q_{P_1} = 46,700$ cfs stage = 12.4' area = 1500 □'

$L_T = 6800'$

$L_1 = \frac{1}{1500\ \square'} \times \frac{43560\ \square'}{acre} \times \frac{261.7\ a\text{-}f}{2}$

$L_1 = 3800'$

6800
3200
3000'

$V_1 = \frac{3800' \times 1500\ \square'}{43560\ \square'/acre} = 130.9$ a-f $\angle \frac{261.7}{2}$ a-f

L is OK

$Q_{P\,trial} = 46,700 \left(1 - \frac{130.9}{261.7}\right) = 23,349$ cfs

stage = 8.4' area = 900 □'

$V_2 = \frac{900\ \square' \times 3800'}{43560} = 78.5$ a-f

$V_{ave} = (130.9 + 78.5)/2 = 104.7$ a-f

$Q_{P_2} = 46,700 \left(1 - \frac{104.7}{261.7}\right) = 28,015$ cfs

stage = 9.4' area = 1120 □'

Job No. 91114 Sheet 23 of 24
Project Jewell Brook #5 Date 2/25/80
Subject Channel Routing By RMC Ch'k. by

$$V_1 = \frac{1120\square' \times 2000'}{43560} = 77.1\ a\text{-}f$$

$L_2 = 3000'$

$$Q_{P\,trial} = 28,015\left(1 - \frac{77.1}{261.7}\right) = 19,758\ cfs$$

stage = 7.7' area = 820 □'

$$V_2 = \frac{820\square' \times 3000'}{43560} = 56.5\ a\text{-}f$$

$\Sigma L = 6800'$

$$V_{ave} = (77.1 + 56.5)/2 = 66.8\ a\text{-}f$$

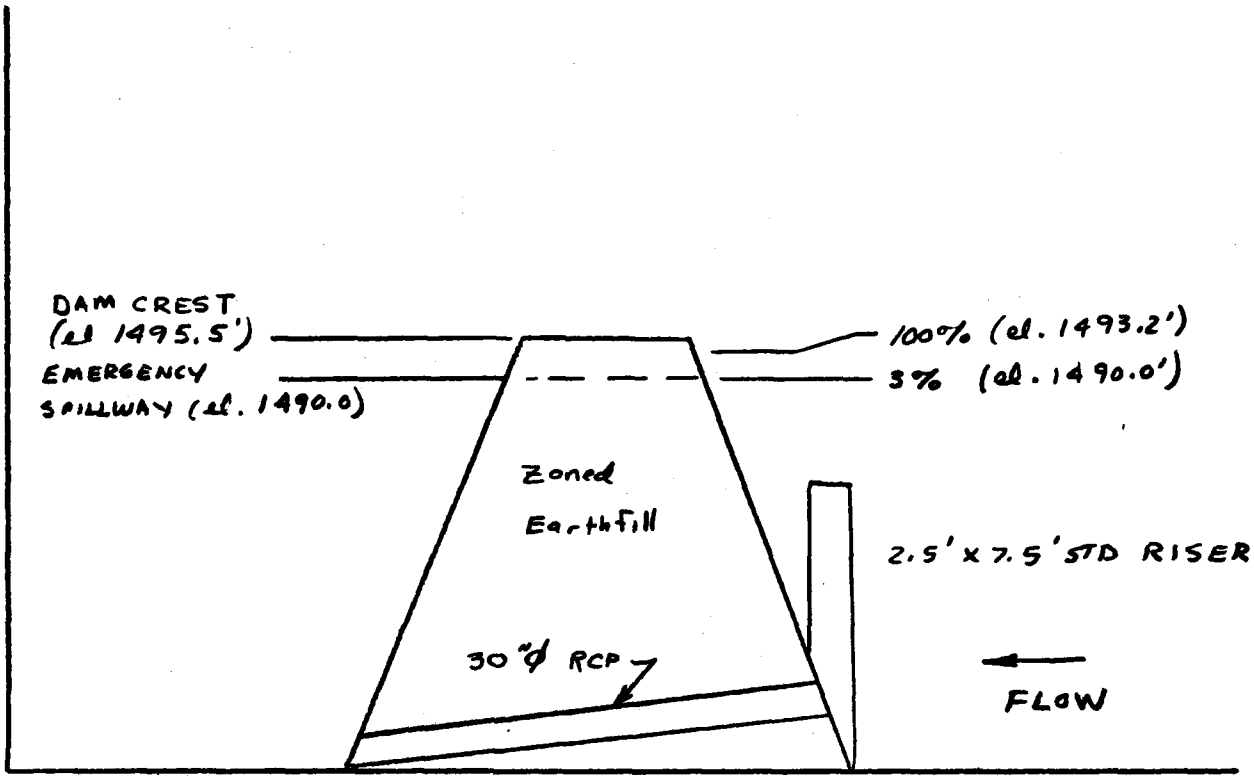
$$Q_{P_2} = 28,015\left(1 - \frac{66.8}{261.7}\right) = 20,865\ cfs \approx 20900$$

OUTFLOW = 20,900 cfs STAGE = 7.9'

SUMMARY

REACH	"SUNNY DAY DAM FAILURE" DISCHARGE	STAGE	"DAM FAILURE DURING TEST FLOOD" DISCHARGE	STAGE
AT DAM	55,300 cfs	19.0'	63,400 cfs test flood stage = 4.3 FLOOD WAVE = Δ stage = 20.2'-4.3' = 15.9'	20.2'
2200' DS (confluence of Sanders-Jewell Brook)	39,500 cfs	16.1'	46,700 cfs test flood stage = 4.3' FLOOD WAVE = 17.6-4.3 = 13.3'	17.6'
↖ 1st floor of several dwellings approximately six feet above streambed at this point				
9000' DS (Enter Village of Ludlow)	17000 cfs	7.0'	20,900 cfs Test flood stage = 3.0 FLOOD WAVE = 7.9 - 3.0 = 4.9'	7.9'

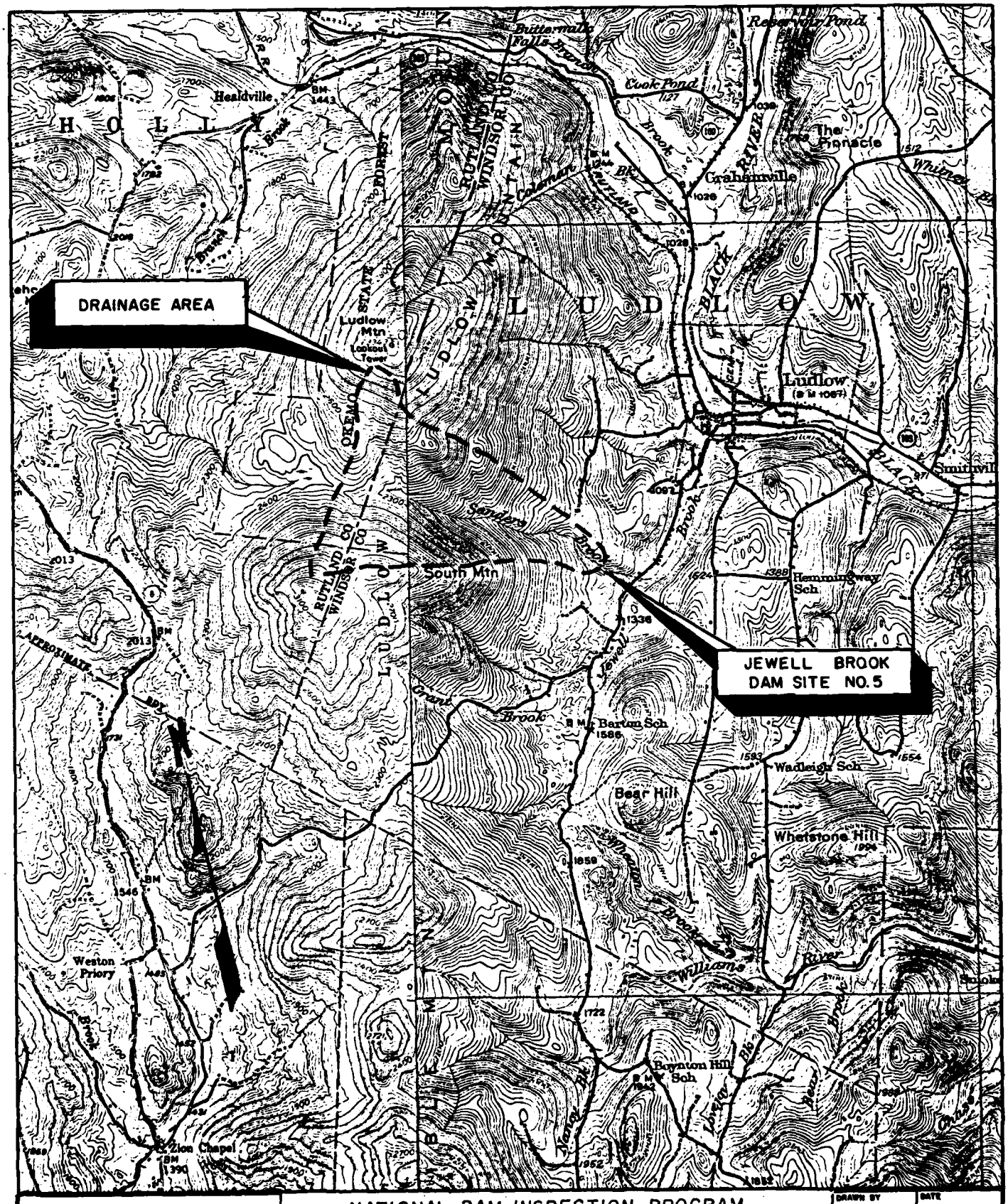
Job No. 91114 Sheet 24 of 24
Project Jewell Brook #5 Date 2/7/80
Subject RESERVOIR DATA By RMC Ch'k. by



NOT TO SCALE

TEST INFLOW = 4600 cfs

RESERVOIR DATA Jewell Brook #5			
% of TEST FLOOD	DISCHARGE (cfs)	DAM CONDITIONS	WATER SURFACE ELEVATION
100%	3852	2.3' FREEBOARD	1493.2'
4%	169	UP TO EMERGENCY SPILLWAY	1490.0



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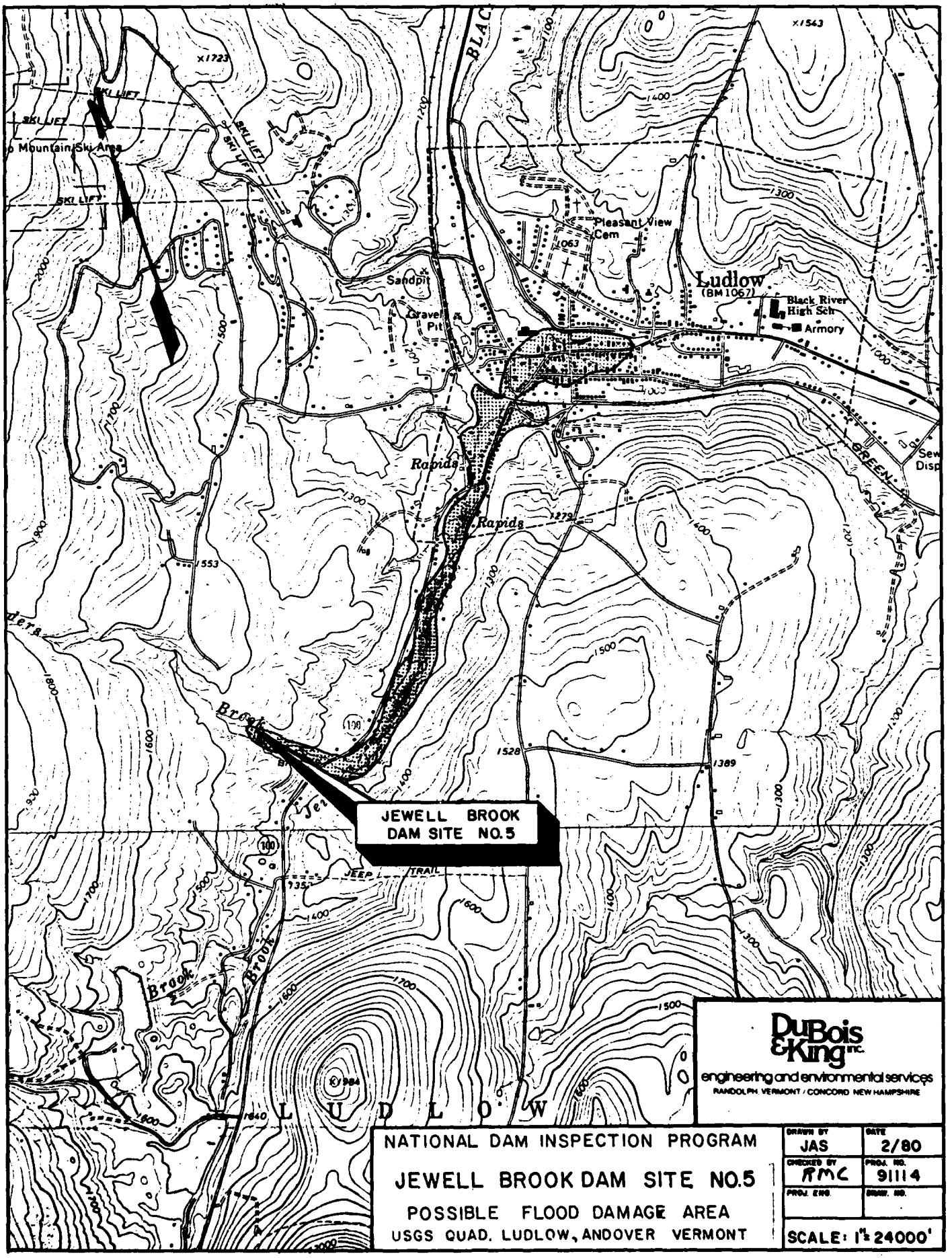
NATIONAL DAM INSPECTION PROGRAM

JEWELL BROOK DAM SITE NO. 5

DRAINAGE AREA

USGS QUAD. LUDLOW, ANDOVER VERMONT

DRAWN BY: JAS	DATE: 2/80
CHECKED BY: RMC	PROJ. NO.: 91114
PROJ. ENG.	DRAW. NO.
SCALE: 1" = 62500'	



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NATIONAL DAM INSPECTION PROGRAM

JEWELL BROOK DAM SITE NO.5

POSSIBLE FLOOD DAMAGE AREA

USGS QUAD. LUDLOW, ANDOVER VERMONT

DRAWN BY: JAS	DATE: 2/80
CHECKED BY: RMC	PROJ. NO.: 91114
PROJ. ENG.	DRAW. NO.

SCALE: 1" = 2000'

AD-A157 229 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
JEWELL BROOK DAM SITE.. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 80

UNCLASSIFIED F/G 13/13 NL

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY / MO / YR
VT	VT00	NE0	VT	027	01				JEWELL BROOK SITE NO. 5	4323.8	7248.3	18JUL80

POPULAR NAME	NAME OF IMPOUNDMENT
	JEWELL BROOK SITE NO. 5 RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	SANDERS BROOK	VILLAGE OF LUDLOW	1	1000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STORAGE (AC-FT)	INVENTORY (AC-FT)	IMPOUNDING CAPACITIES MAXIMUM (AC-FT)	IMPOUNDING CAPACITIES NORMAL (AC-FT)
RE RC	1972	C	112	100	342	18

DIST OWN FED R PRV/FED SCS A VEH/OTHR
NED N N N B

REMARKS

D/S HAS	SPILLWAY LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED	POWER CAPACITY PROPOSED	NAVIGATION LOCKS
1	650	U	300	10825	225000			

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF LUDLOW VT.	USDA SOIL CONS. SERVICE	TORRINGTON CONST. CO.

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
VT DEPT WTR RES	VT DEPT WTR RES	VT DEPT WTR RES	VT DEPT WTR RES

INSPECTION BY	INSPECTION DATE DAY / MO / YR	AUTHORITY FOR INSPECTION
DUBOIS & KING INC.	04NOV78	P.L. 83-566

REMARKS

END

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